This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

NYPL RESEARCH LIBRARIES
3 3433 06640050 2

Americ
Foundry

JOURNAL

of the

American Foundrymen's Association.

A Compendium of Contemporary Foundry Thought.

In Three Parts.

NEW YORK PUBLIC LIBRARY

EDITED BY

RICHARD MOLDENKE, E. M., Ph. D.,
Secretary of the Association.

Volume XI.

Part I	- -	Papers.
Part II	-	Proceedings.
Part III	- -	Reviews.

NEW YORK, 1902 1903.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS
1933 L

Journal of the American Foundrymen's Association.

PAPERS.

VOL. XI. PART I.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX
AND TILDEN
FOUNDATIONS
R 1933

NEW YORK
PUBLIC
LIBRARY

PUBLIC LIBR
ASTOR, LENOX A
TILDEN FOUNDATIO

INDEX—VOLUME XI.

I Accounting, Foundry, ... 77
III Accounting, Foundry, ...56, 88
III Acid proof Cast Iron, ... 3
III *Age of Steel,* 16, 21,26
III Aluminum, casting, ... 41
III *Aluminum World,* the, ...24, 44
III Alloys, fusible, ... 73
II American Foundrymen's Association, Boston Convention, ... 3
II American Foundrymen's Ass'n, Officers elected, ... 55
III *American Institute of Mining Engineers,*..... 52
III *American Machinist,* 16, 27, 29, 32, 34, 51, 61
III *American Manufacturer,* 27, 28
II *American Society for Testing Materials,* 33, 81
III *American Society of Mechanical Engineers,*..... 58
II Analysis, Standard Methods, Report on, ... 22
III Annealing, Continuous, ... 46
III Annealing Process, Silicon in, ... 53
III Annealing White Castings, ... 77
I Apprenticeship Period, reduce the, ... 93
III Arsenic in Brass Castings, ... 27
III Associations, Employers', ... 86
III Atha, H. B.: Sand Molds for Steel Castings, ... 28
II Auditing Committee, Report of, ... 14
III Barrows, O. C.: Factory Accounting, ... 88
III *Baumaterialienkunde,* 48
II Bell, C. S.: Response to Address of Welcome, ... 9
III Blackmore, J. J.: Cast Iron Boilers, ... 76
III Blowers, Rating Pressure, ... 78
III Boilers, Sectional Cast Iron, ... 76
II Boston Convention of the American Foundrymen's Ass'n, ... 3
III Brass Castings, Arsenic in, ... 27

III Brass, coloring, black, ... 89
III Brass, dipping, ... 72
III Bosses, molding, on Castings, ... 32
III *Brass Founder and Finisher*, ...9, 52, 56, 72, 73
I Brass Melting, ... 35
III Brass on Iron, burning, ... 44
III Breast for Cupola, ... 38
III Buchanan, J. F.: Burning Brass on Iron, ... 44
III Buchanan, Geo.: Skin dried Molds, ... 72
III Buchanan, R. H.: Crane Service for the Foundry,.... 63
III Buchanan, R. H.: Cupola Practice, ... 85
III Buchanan, R. H.: Machine and Hand Molding, ... 79
III Buchanan, R. H.: Specifications for Coke, Iron and Sand, ... 79
III Buchanan, R. H.: Test Bars, ... 23
III Burning Brass on Iron, ... 44
III Carbide of Silicon for Foundry Use, ... 71
II Carbon, Combined, Methods of Determining, ... 199
I Carbon in Cast Iron, ... 63
I Carbon in the Cupola Process, ... 53
I Carbon in Steel, ... 62
II Carbon, total, Methods of Determining, ... 183
II Carpenter, H. A.: Address of Welcome, ... 5
III Carr, W. M.: Treatment of Steel Castings, ... 21
III Car Wheels, Cast Iron, ... 21
III Car Wheels, chilled Cast Iron, ... 20
III Car Wheels, the alleged Decadence of, ... 7
III *Cassier's Magazine*, ... 39
III Castings, annealing white, ... 77
III Casting Pipe in Germany, ... 14
II Castings, steel, standard Specifications for, ... 33
III Castings, Weight of, ... 52
I Cast Iron, ... 61
II Cast Iron, Committee on standard Specifications on.. 201
III Cast Iron, Compression of, ... 27
III Cast Iron, Effect of Variations of Constituents in,.... 45
III Cast Iron for Superheaters, ... 48
II Cast Iron, Heat Treatment for, ... 90
I Cast Iron, Malleable, ... 101

III Casting Iron on Steel Shafts, ... 58
III Cast Iron sectional Steam Boilers, ... 76
III Cast Steel, Compression of, ... 27
III Cellini as a Foundryman, ... 55
III Chemistry and Cupola practice, ... 43
II Chemists and Metallurgists, Foundry, Section for, .. 63
III Chilled surfaces, Streaks on, ... 76
III Chilled Rolls, breaking of, ... 14
III Chills, Treatment of, ... 28
III Coke, ... 47
III Coloring Brass black, ... 89
I Column, Core for, ... 21
II Combined Carbon, Methods for determining, ... 199
II Committee on standard Specifications for Cast Iron,.. 201
III Compression of Iron and Steel Castings, ... 27
I Conditions, Shop, ... 15
II Conlin, F.: Insuring Patterns, ... 36
III Continuous Annealing, ... 46
III Contraction Test, ... 50
II Contraction Test for Metals, ... 91
II Convention Entertainment, ...3, 43, 44, 52, 54
II Convention of the American Foundrymen's Ass'n in Boston, ... 3
III Copper, Iron in, ... 72
I Cores and Core Arbors, ... 17
III Cost Keeping, ... 46
III Cost Keeping, Foundry, ... 18
I Costs, Foundry, ... 43
III Costs, Foundry, ... 49
III Cost System, ... 47
III Crane Service for the Foundry, ... 63
III Cupolas, new Method of lining, ... 64
I Cunningham, R. C.: Foundry Costs, ... 43
III Cunningham, R. C.: Melting Steel with Cast Iron, .. 69
III Cupola Breast, the, ... 38
III Cupolas, Improvement in, ... 5
III Cupola Linings, ... 26
I Cupola, Metallurgy of, ... 49
III Cupola Mixtures, Regulation of, ... 74

III Cupola Practice, ... 85
III Cupola Practice and Chemistry, ... 43
III Cupola Practice, modern, ... 73
III Cupola Process, Fan Blower for, ... 62
I Cupola, Steel with Iron in, ... 25
I Cupola, the Study of, ... 97
I Cylinder, marine, Crown Case for, ... 18
III Day's Work, the, ... 11
III Decadence of Car Wheels, the alleged, ... 7
III Decisions, Organized Labor, ... 74
III Development of the Foundry Industry, ... 7
I Diller, H. E.: Malleable Cast Iron, ... 101
I Diller, H. E.: Melting Steel with Iron in the Cupola,. 25
III Dipping Brass, ... 72
II Discussion on the Foundry Trade School, ... 24
II Discussion on grading Pig Iron by Analysis, ... 20
II Discussion on increasing Foundry Production, ...45, 78
II Discussion on melting Steel with Iron, ... 50
II Discussion on Shop Conditions, ... 47
II Discussion on standardizing Cast Iron Pipe, ... 76
II Discussion on standard Methods of sampling Iron, ... 80
II Discussion on the Melting Ratio, ... 71
II Discussion on the Molding Machine, ... 66
II Doyle, J. H.: Address of Welcome, ... 7
III Dressing Castings, ... 44
I Economy, ... 39
I Education, technical, ... 95
III *Eisenzeitung*, ...3, 14, 45, 61, 63, 75
III Employer and Employee, ... 83
III Employers' Associations, ... 86
III Employers' Organization, German National, ... 61
III *Engineering Magazine*, ...49, 63, 79, 85, 88
III *Engineering Record*, ...48, 76
III English Foundry Development, ... 75
II Entertainment at the Convention, ...3, 43, 44, 52, 54
III European Foundry Practice, ... 59
III European Malleable Castings Plant, ... 70
III Facings, Foundry, ...58, 59
III Falconer, Kenneth.: Foundry Accounting, ... 56

III Fan Blower for Cupola Process, ... 62
III Fawcett, W.: Alleged Decadence of Car Wheels, ... 7
III Feeding Castings, ... 42
II Field, H. E.: Metallurgical Section of the A. F. A., .. 107
I Field, H. E.: Metallurgy of the Cupola, ... 49
II Field, H. E.: Methods of determining Silicon, ... 129
Sulphur, ... 137
Manganese, .. 167
Phosphorus, .. 151
Total Carbon,. 183
Graphitic Carbon, ... 193
Combined Carbon, ... 199
II Field, H. E.: Standard Methods for Analysing Iron,.. 125
III First Foundry in America, ... 12
I Flask Pins, ...10, 73
III Flasks, Combination Iron, ... 34
III Flasks, Foundry, ... 16
I Flour for Cores, ... 39
III Flux, Plaster Paris as brass, ... 44
III Foreign Foundry Pig Iron, ... 59
II Foremen's Association, Foundry, ... 59
III Foundries in U. S. and Canada, ... 6
III Foundries, Malleable, in U. S. and Canada, ... 85
III Foundries, Steel, in U. S. and Canada, ... 78
I Foundry Accounting, ... 77
III Foundry Accounting, ...56, 88
I Foundry Costs, ... 43
III Foundry Costs, ... 49
III Foundry Development, ... 7
III Foundry Development in England, ... 75
II Foundry Experience needed for testing Cast Iron,.... 88
III Foundry Facings, ...58, 59
II Foundry Foremen's Association, ... 59
I Foundry Industry, Future of, ... 111
III Foundry Iron and melting Methods, ... 4
II Foundry Metallography, ... 69
II Foundry Metallurgists, Section for, ... 63

III Foundry, Metallurgy in the, ... 61
III Foundry Practice, European, ... 59
III Foundry Progress, ... 51
III Foundry Questions, ... 49
III Foundry Rigs, ... 84
III Foundry Supplies, Specifications for, ... 23
III *Foundry,* the, 5, 6, 9, 11, 41, 42, 43, 44, 45, 59, 60, 64, 68, 71, 72, 73, 77, 80, 84
III Foundry, the, ...13, 61
III Foundry, the first, in America, ... 12
II Foundry Trade School, ... 23
III Foundry Waste, ... 68
III Frohman, E.: Sea Coal, ... 59
III Fuller, B. D.: Gates and Sprues, ... 81
III Fusible Alloys, ... 73
I Future of the Foundry Industry, ... 111
III Gates and Sprues, ... 81
III German Employers' Organization, ... 61
II German Foundrymen's Association, Proceedings of, . 97
III German Silver, ... 42
I Gilmour, E. B.: Cores and Core Arbors, ... 17
III Gordon, F. E.: Molding Sand, ... 87
III Grading and Mixing Iron by Analysis, ... 71
III Grading of Pig Iron, ... 88
II Grading Pig Iron by Analysis, Report on, ... 20
III Graham, J. W.: Molding from Half-Patterns, ... 73
II Graphitic Carbon, Methods for determining, ... 193
III Grau: Foundry Iron and melting Methods, ... 4
III Half-Patterns, molding from, ... 73
III Hand and Machine Molding, ... 79
III Hayward, R. B.: Fan Blower, ... 62
II Heat Treatment for Cast Iron, ... 90
III Henshaw, F. V.: Casting Iron on Steel, ... 58
III Hicks, G. C. Jr.: Rotary Pressure Blowers, ... 78
III Hunter, Dr.: Annealing white Castings, ... 77
III Hydraulic Castings, Phosphor Bronze for, ... 9
III Hyndman, N. P.: Coke, ... 47
III Improvement in Cupolas, ... 5
I Increasing Foundry Production, ... 29

II Increasing Foundry Production, Discussion on, ... 45
III Ingot Molds, Life of, ... 69
III Influence of proper Cupola Practice, ... 9
II Insuring Patterns, Memorial on, ... 36
III *Iron Age*, the, ...9, 50, 59, 62, 70, 74, 83, 86, 88, 89
II *Iron and Coal Trades Review*, ... 76
III Iron in Copper and its Alloys, ... 72
III *Iron Molders Journal*, the, ...24, 76
III *Ironmonger*, the, ...23, 90
III *Iron Trade Review*, the, 7, 11, 15, 18, 20, 21, 22, 28, 46, 47, 50, 58, 59, 60, 69, 71, 78, 81, 85, 87
III Jewett, L. C.: Feeding Castings, ... 42
I Jig Plate, ... 4
I Jigs, ... 1
I Kaolin for Cupola daubing, ... 98
III Keep, W. J.: Recovering Iron from Cinders, ... 80
III Keep, W. J.: Regulation of Cupola Mixtures,..... 74
II Keep, W. J.: The Melting Ratio, ... 72
III Kirchhoff, Chas.: Consolidations, ... 50
III Kirk, Dr. E.: Chemistry and Cupola Practice,..... 43
III Kirk, Dr. E.: Foundry Rigs, ... 84
III Kirk, Dr. E.: Improvements in Cupolas, ... 5
III Kirk, Dr. E.: Mixing Iron by Analysis, ... 71
II Kreuzpointer, P.: The Ethics of Testing, ... 82
III Labor, organized, Decisions on, ... 74
III Labor Saving Machinery for the Foundry,..... 39
III Lebeau, P.: Silicon in Cast Iron, ... 8
III Ledebur, Prof. A.: Silicon in Annealing, ... 53
III Life of Ingot Molds, ... 69
I Lifting Chain, ... 70
III Light, Action of, on colored Laquers,..... 52
III Limitation of Output, ... 77
III Lining Cupolas, new method of,..... 64
III Lining of Cupola, ... 26
I Longmuir, Percy: Cast Iron, ... 61
III Longmuir, Percy: Dressing Castings, ... 44
III Longmuir, Percy: Foundry Costs, ... 49
III Longmuir, Percy: German Silver, ... 42
III Longmuir, Percy: Metallography in the Foundry,.. 61

I Loudon, A. M.: The Melting Ratio, ... 99
III Loudon, A. M.: The Riser, ... 60
I Loudon, A. M.: The Study of the Cupola, ... 97
III Machine and Hand Molding, ... 79
III Machinery for the Foundry, ... 39
III Malleable Casting Plant in Europe, ... 70
I Malleable Cast Iron, ... 101
I Malleable Cast Iron, Requirements for, ... 103
III Malleable Industry of America, ... 85
III Malone, T. E.: Foundry Facings, ... 58
I Manganese in the Cupola Process, ... 52
II Manganese, Methods of determining, ... 167
I Marine Cylinder, Crown Case for, ... 18
III May, W. J.: Cupola Linings, ... 26
III May, W. J.: Testing Iron, ... 50
I McPhee, Hugh.: Shop Conditions, ... 15
III *Mechanical World,* the 50
I Melting Brass, ... 35
III Melting Brass with Oil and Gas, ... 41
III Melting Methods, and Foundry Iron, ... 4
II Melting Ratio, the, ... 71
I Melting Ratio, the 99, 119
III Melting Steel with Cast Iron, ... 69
I Melting Steel with Iron in Cupola, ... 25
II Memorial on insuring Patterns, ... 36
II Memorial on Valuation of Pig Iron, ... 40
III Metallography for Car Wheel Manufacture, ... 9
II Metallography in Foundry Work, ... 69
III Metallurgical Problems, ... 25
II Metallurgical Section of the A. F. A., ...
107, 125, 129, 137, 151, 167, 183, 193, 199
III Metallurgy in the Foundry, ... 61
I Metallurgy of the Cupola, ... 49
III Miller, J. A.: Organized Labor Decisions, ... 74
III Mixing and Grading Iron by Analysis, ... 71
III Modern Cupola Practice, ... 73
I Moldenke, Dr. R.: Future of the Foundry Industry,.. 111
III Moldenke, Dr. R.: Machinery for the Foundry, ... 39
II Moldenke, Dr. R.: Memorial on valuing Pig Iron,.. 40

II Moldenke, Dr. R.: Present Status of testing Cast Iron, 86
II Moldenke, Dr. R.: Secretary's Report, ... 9
II Moldenke, Dr. R.: The Melting Ratio, ... 71
I Moldenke, Dr. R.: Valuation of Pig Iron for Foundry, 105
III Moldenke, Dr. R.: Valuation of Pig Iron for Foundry, 63
III Molding Bosses on Castings, ... 32
III Molding by Hand and Machine, ... 79
III Molding from Half-Patterns, ... 73
II Molding Machine, Discussion on, ... 66
I Molding Machine, the, ...1, 9
III Molding Pipe without Patterns, ... 29
III Molding Sand, ... 87
III Molds for Steel Castings, ... 45
III Molds, skin-dried, ... 72
III Moyer, A. W.: Overhead Tramway Systems for Factories, ... 70
III Murphy, J. A.: Limitation of Output, ... 77
I Murphy, J. A.: Shop Tools and Rigs, ... 69
I Murphy, J. A.: The Melting Ratio, ... 119
I Night Work in the Foundry, ... 30
II New England Foundrymen's Ass'n, Proceedings of,.. 105, 122, 205
III New England Water Works Ass'n, Standard Specifications, ...48, 76
III New Molding Process, ... 16
II Officers of the A. F. A., elected, ... 55
III Organized Labor Decisions, ... 74
III Osann, B.: Foundry Questions, ... 49
III Osann, B.: Malleable Casting Plant in Europe, ... 70
III Osann, B.: Steel Castings and their Use, ... 67
II Outerbridge, A. E. Jr.: Heat Treatment of Cast Iron,. 90
III Outerbridge, A. E. Jr.: Heat Treatment of White Castings, ... 28
III Output, Limitation of, ... 77
III Overhead Tramrail System for Foundries, ... 70
III Palmer, R. H.: Combination Iron Flasks, ... 34
III Palmer, R. H.: The Foundry, ... 61
II Patterns, Memorial on insuring, ... 36
III Pattern Metal, ... 43

II Park, Prof, C. F.: Address of Welcome, ... 8
III Pepper, J. H.: Continuous Annealing, ... 46
III Pfahler, W. H.: Employer and Employee, ... 83
II Philadelphia Foundrymen's Ass'n, Proceedings of.. 93, 103, 112, 206
III Phosphor Bronze for Hydraulic Castings, ... 9
III Phosphorizing Metals, ... 24
I Phosphorus in Cupola Process, ... 52
II Phosphorus, Methods of determining, ... 151
III Pickup: European Foundry Practice, ... 59
III Pig Iron, Foreign Foundry, ... 59
III Pig Iron for Foundry, Valuation of, ... 63
II Pig Iron, grading by Analysis, Report on, ... 20
III Pig Iron, the grading of, ... 88
I Pig Iron, Valuation for Foundry Purposes, ... 105
II Pig Iron, Valuation for the Foundry, ... 40
I Pins, Flask, ... 10
III Pipes and Special Castings, Standard, ... 76
III Pipe casting in Germany, ... 14
I Pipe Connection, Core for, ... 23
II Pipes, Cast Iron, standardizing, ... 76
III Pipe Founding by a State, ... 90
III Pipes, molding without Patterns, ... 29
II Pipe Specifications for, ... 91
III Pipe, Specifications for Cast Iron, ... 48
II Pittsburg Foundrymen's Ass'n, Proceedings of, ..101, 120
III Plaster Paris as Brass Flux, ... 44
I Plate Molding, ... 1
I Plumbago, ... 40
III Pouring Temperature, ... 11
III Pressure Blower, rating, ... 78
II Proceedings of the A. F. A., Boston Convention..... 3
II Proceedings of the American Society for testing Materials, ... 81
II Proceedings of the German Foundrymen's Ass'n, ... 97
II Proceedings of the Metallurgical Section, ... 107, 125, 129, 137, 151, 167, 183, 193, 199
II Proceedings of the New England Foundrymen's Ass'n, 105, 122, 205

II Proceedings of the Philadelphia Foundrymen's Ass'n, 93, 103, 112, 206
II Proceedings of the Pittsburg Foundrymen's Ass'n, . 101, 120
II Proceedings of the St. Louis Foundrymen's Ass'n, . . 92
I Production, increasing Foundry, ... 29
III Projectiles, Specifications for Cast Iron, ... 47
III Putnam, E. H.: A metallurgical Problem, ... 25
III Putnam, E. H.: Cupola Breasts, ... 38
I Putnam, E. H.: Reduce the Apprentice Period, ... 93
III Putnam, E. H.: Scabbing, ... 26
III Putnam, E. H.: Snap-flask Work, ... 21
III Putnam, E. H.: Stars, ... 22
III Putnam, E. H.: Treatment of Chills, ... 28
III Questions, Foundry, ... 49
I Ramp, P. R.: Economy, ... 39
III Ramp, P. R.: Foundry Flasks, ... 16
III Rating Pressure Blowers, ... 78
III Rat Tails, ... 24
III Recovering Iron from Cinders, ... 80
III Refractory Cast Irons, ... 3
III Regulation of Cupola Mixtures, ... 74
I Reid, David,: Increasing Foundry Production, ... 29
II Report of Auditing Committee, ... 14
II Report of Secretary, ... 9
II Report of Standardizing Bureau, ... 16
II Report of Treasurer, ... 14
II Report on Foundry Trade School, ... 23
II Report on grading Pig Iron by Analysis, ... 20
II Report on standard Methods of Analysis, ... 22
II Report on standard Methods of sampling Iron, ... 17
III Reusch, P.: Life of Ingot Molds, ... 69
III Richardson, J. H.: Molding Bosses on Castings, ... 32
I Richards, Prof. R. H.: Technical Education, ... 95
I Rigs and Tools, Shop, ... 69
III Rigs, Foundry, ... 84
III Risers, ... 64
III Riser, the, ... 60
III Rott, C.: Acid proof and refractory Iron, ... 3
II St. Louis Foundrymen's Ass'n, Proceedings of, ... 92

II Sampling Pig Iron, specifications for, ... 18
II Sampling Pig Iron, Report on standard Methods for,. 17
III Sand Blast, the, ... 15
III Sand Mold for Steel Castings, ... 28
III Sarg, E.: Molds for Steel Castings, ... 45
II Sauveur, Prof. A.: Metallography, ... 69
III Saving the Scrap Pile, ... 60
III Scabbing, ... 26
III Schwerin, C. M.: Calculating weight of Castings, ... 52
III Scott, W. G.: Effect of Variation in Constituents in Cast Iron, ... 45
II Scott, W. G.: Mixtures, ... 83
III Scott, W. G.: Specifications for Foundry Supplies, .. 23
II Scott, W. G.: The Melting Ratio, ... 73
III Scrap Pile, saving, ... 60
III Sea Coal, ... 58, 59
II Secretary's Report, ... 9
III Shaw, F. W.: Molding Pipes without Patterns 29
I Shop Conditions, ... 15
II Shop Conditions, Discussion on, ... 47
I Shop Tools and Rigs, ... 69
III Silicon Carbide for Foundry Use, ... 71
III Silicon in Annealing Process, ... 53
III Silicon in Cast Iron, ... 8
I Silicon in Cupola Process, ... 51
II Silicon, Methods of determining, ... 129
III Shot Iron, recovering, ... 80
III Skin-dried Molds, ... 72
III Smith, H.: Action of Light on colored Laquers,..... 52
III Snap-flask Work, ... 21
III Specifications for Cast Iron Pipe, ... 48
III Specifications for Cast Iron Projectiles, ... 47
III Specifications for Coke, Iron, Sand, ... 79
III Specifications for Foundry Supplies, ... 23
II Specifications for sampling Iron, ... 18
II Specifications for Steel Castings, standard, ... 33
II Specifications for Cast Iron, standard, Committee on,. 201
II Sperry, E. S.: Arsenic in Brass Castings, ... 27
Sperry, E. S.: Dipping Brass, ... 72

III Sperry, E. S.: Iron in Copper and its Alloys, ... 72
III Sperry, E. S.: Pattern Metal, ... 43
III Sperry, E. S.: Phosphor Bronze for hydraulic Castings, 9
III Sperry, E. S.: Phosphorizing Metals, ... 24
III Sperry, E. S.: Plaster Paris in Brass Founding, ... 44
III Sprues and Gates, ... 81
III *Stahl und Eisen,* 4, 8, 49, 53, 67, 69
II Standardizing Bureau, Report on, ... 16
II Standard Methods of analysing Iron, ... 125
II Standard Methods of Analysis, Report on, ... 22
III Standard Pipes and special Castings, ... 76
II Standard Specifications for Cast Iron, Committee on,. 201
III Stars, ... 22
III State as a Pipe Founder, ... 90
III Steel, casting Iron on, ... 58
III Steel Castings and their Use, ... 67
III Steel Castings, Molds, for, ... 45
II Steel Castings, standard Specifications for, ... 33
III Steel Castings, Steel Molds for, ... 28
III Steel Castings, Treatment of, ... 21
III Steel Foundries in the U. S. and Canada, ... 78
III Steel, melting with Cast Iron, ... 69
I Steel with Iron in the Cupola, ... 25
II Steel with Iron, melting, Discussion on, ... 50
I Stewart, J. G.: Foundry Accounting, ... 77
III Stickle, F. W.: Modern Cupola Practice, ... 73
III Stickle, F. W.: Pouring Temperature, ... 11
III Stickle, F. W.: Proper Cupola Practice, ... 9
III Streaks on chilled Surfaces, ... 76
III Strength of white Iron Castings under Heat Treatment, 28
I Study of the Cupola, the, ... 97
I Stupakoff, S. H.: The Molding Machine, ...1, 9
II Stupakoff, S. H.: The Molding Machine, ... 66
I Sulphur in Cupola Process, ... 51
II Sulphur, Methods of determining, ... 137
III Superheaters, Cast Iron for, ... 48
I Table of Tests on Steel and Cast Iron Mixtures, ... 27
III Tabor, Harris: Foundry Progress, ... 51
I Technical Education, ... 95

III Test Bars, ... 23
II Testing Cast Iron, Need of Foundry Experience for, .. 88
II Testing Cast Iron, Present Status of, ... 86
III Testing Iron in small Foundries, ... 50
I Tests of Steel with Iron Mixtures, ... 27
III *Tin and Terne,* 14
II Total Carbon, Methods of determining, ... 183
I Tools and Rigs, Shop, ... 69
II Trade School, Report on Foundry, ... 23
III *Tradesman,* the, ...13, 21, 22, 25, 26, 28, 38
III Tram-rail System, overhead, ... 70
II Tratman, E. E. R.: The Melting Ratio, ... 71
II Treasurer's Report, ... 14
III Trusts, ... 50
III Tuttle, H.: Casting Aluminum, ... 41
I Valuation of Pig Iron for Foundry, ... 105
II Valuation of Pig Iron for Foundry, Memorial on,.... 40
III Valuation of Pig Iron for Foundry, ... 63
III Vanier, E. H.: Chilled Cast Iron in Car Wheels, ... 20
I Vickers, Chas.: Melting Brass, ... 35
III Ward: Saving the Scrap Pile, ... 60
II Ward, W.: Specifications for Iron Pipe, ... 91
III Warren, A. G.: The Sand Blast, ... 15
III Waste in the Foundry, ... 68
III Weight of Castings, ... 52
II West, Thos. D.: Foundry experience for testing Cast Iron, ... 88
II West, Thos. D.: Treasurer's Report, ... 14
III Whitney, A. W.: Contraction Test, ... 50
II Whitney, A. W.: Contraction for Metals, ... 91
III Whitney, A. W.: Metallography for Car Wheels, ... 9

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

THE MOLDING MACHINE.

BY S. H. STUPAKOFF, PITTSBURG, PA.

JIGS.

The deduction arrived at in the foregoing chapter might make it appear that plated patterns are not likely to find an extensive use in jobbing foundries, whereas this is really not altogether the case. There is no doubt that plate molding in its present shape, or rather as ordinarily applied, is practically excluded from jobbing shops. But, if a plate is used in connection with a suitable jig, specially prepared for the purpose, objections are not only overcome, but the application and use of plates offer excellent advantages, even in such cases where only a small number of castings of the same pattern are required at one time. At best, the economic use of plated patterns is limited by the shape and size of the castings. The fundamental principle involved in their construction and application must be fully understood by the user, if satisfactory results are expected.

Irrespective of its relation to the molding machine, it would seem that this subject—on its own merits—is of such importance, that it should be investigated by all foundrymen. It should specially interest the majority of our members. I have therefore somewhat enlarged the scope of this treatise on the molding machine by including a detailed study of the construction and modus operandi of this particular contrivance.

To begin with, it should be understood that all plates are provided with guide-pin holes, which are accurately fitted to corresponding guide pins forming part of the flasks. Unless special flasks are used in connection with such plates the customary flask pins should not be confounded with these guide pins, as they will never answer the purpose. In order that mis-conceptions in this respect may be avoided, this term will be adhered to in what follows, and strict distinction will be made between

flask-pins and guide-pins wherever they may be mentioned in the course of this work.

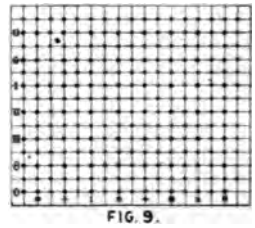


FIG. 9.

The guide-pin holes, G and G¹, Fig. 9, are preferably arranged on opposite ends of the plate, in even multiples of an inch, and equi-distant from its center and on a line dividing the plate into two equal rectangles. There are exceptional cases, in which three or four guide-pins must be used. The most serious objection against this arrangement is the greater difficulty experienced in locating the patterns correctly.

Accuracy in preparing the plates becomes of the utmost importance, as the magnitude of all errors occurring in the original laying out is doubled by each subsequent operation. The guide-pin holes should be drilled and reamed out at right angles to the surface of the plate, and it is advisable to provide them with hardened and ground steel bushings. All guide-pins should be of uniform diameter irrespective of the size of the plate. A pair of test pins should be kept on hand, which snugly fit the guide-pin holes; one-half of one of their ends should have been cut down to about ¾" in length, leaving as remainder *exactly* one-half of the cylindrical portion. (Fig. 7). If these test pins are inserted into their respective holes and a straight edge be placed against their flattened faces, it will serve for locating the base or the center line of the plate, for marking off and laying out the dowel pin holes, arranging the patterns and checking off all work relating to it.

The exact location of the center of the plate, and likewise the center of the flask, is found by dividing the base line from center to center guide-pin hole into two equal parts. Let us drill a hole C in this place, (fig. 8) and let this hole serve as the starting point for future operations. Now we will assume that we have procured a tri square with a row of holes drilled in each of its legs; these holes are spaced equally—say 1 inch apart—

care being taken that each row stands exactly in a straight line, and that both rows include an exact angle of 90 degrees. We place this square in such a manner on our plate that the hole in its apex corresponds with the center hole C of our plate, and insert a good fitting dowel pin through both. Thus we are able to shift the square over the whole surface of the plate by turning it around the center pin. Next we bring one leg of the square over the base line of the plate and insert a second dowel pin (which may be shouldered if necessary) through G into the corresponding hole of our square. Secured in this manner the square should be absolutely rigid and should not shake to right or left on the surface of the plate. We now drill one hole each into the plate through the guides H and I of the square, then we remove the pin from G, turn the square around the center pin over 90 degrees, so that one of its legs points upward and the other one to the left, insert a dowel through the hole in the leg pointing upward into the top hole I^1 of the plate, and drill the hole H^2; finally we turn it again over 90 degrees, secure it in the same manner as before, and drill the hole I^2. Figure 8 illustrates the square in the first position as located on the plate; the holes H^2 and I^2 which are drilled subsequently, are shown in faint lines. We shall call these holes, in the future, "pilot holes," in order to distinguish them from others in the same plate. These four pilot holes include an exact rectangle or square, and each opposite pair is located at uniform distances from the center of plate and flask. It will be understood that it is not absolutely necessary to employ the square for drilling the pilot holes. For instance, after one plate has been prepared in this manner, this plate can serve as a jig for drilling any number of additional plates in the same manner by a single setting. Such an original or master plate is especially serviceable, if all holes are provided with good steel bushings. The pilot holes in connection with the center hole will serve us hereafter as guides for locating pattern dowels.

Our object in view is to use this plate as a base for any and all suitable patterns, and as an illustration we will arrange it for the reception of patterns of a globe valve and a bib cock. We will assume that the patterns are all in good shape and properly parted. However, they shall originally not have been intended for use with either molding machine or drawplate. Our plate

and flask are of a suitable size, but the job is in a hurry—as all jobs are—and we must get out quite a number of these castings to-day. What are we going to do about it? Take my advice and make it in the old fashioned way, unless you are provided with a suitable jig plate and an inexpensive, but a good small drill press, which was never used by your blacksmiths or yard laborers, but was expressly reserved for this purpose only, was always under the care of a mechanic who understood *how* to handle it, and who took pride in keeping it in good shape.

This jig plate (fig. 9) should be provided with a number of holes, two rows of which, at least, are drilled exactly in the same manner as those in the above mentioned square; the balance are laid out preferably, but not necessarily so, in straight and parallel lines, all equi-distant from each other. Its dimensions should be sufficient to cover one corner, or one-fourth of your pattern plate.

If these things are part of your equipment you will have easy sailing, and you will be better fitted to tackle the job than your competitor.

Place this jig in such a manner in one corner of your draw plate that the hole O (fig. 9) corresponds with the hole C in its center, hold both together with dowel pins inserted into the pilot holes, and drill the holes through the jig into your plate, which are required for securing the patterns in the predetermined places. To avoid mistakes be sure that the hole in that particular corner of the jig, which corresponds to the one described as located in the apex of the square is distinctly marked on both sides of the jig plate—in our figure marked O—and note carefully which holes in the jig were used for drilling the dowel holes into the pattern-plate. Thereafter turn the jig upside down on the pattern plate, insert the dowel pins again through the same holes O and OI into C and I^1, and the third one through OH into H^2, and then, as before, drill through the same guide holes of the jig the corresponding dowel holes into the second quarter of the pattern plate. Repeat the same process at the lower half of the plate, being always careful that C and O remain together and your plate is ready to receive the patterns.

That there may be no doubt as to the method of operation, I suggest that you will refer to the two plates which are attached

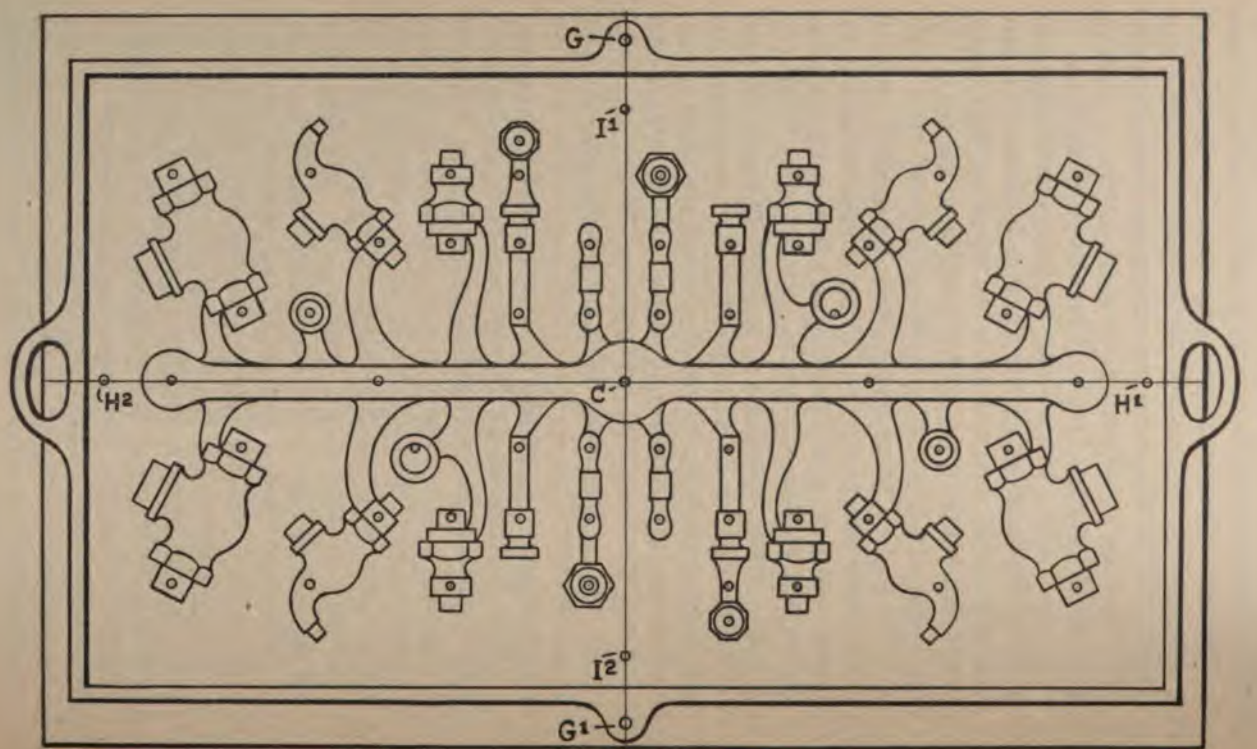


FIG. 11.

Fig. 10

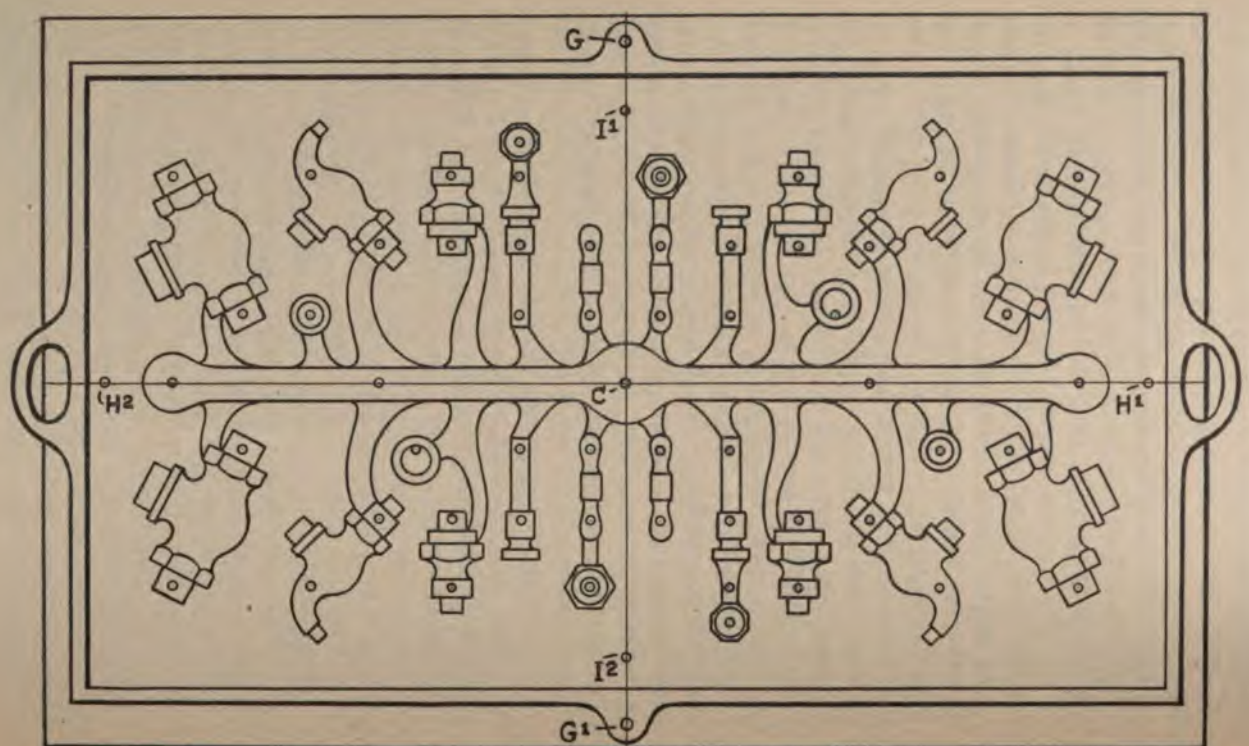


FIG. 11.

hereto, one of which (Fig. 10) is made on transparent—so called "onion skin" paper. The cut on the latter represents the jig. In faint lines thereon is shown the outline of the position of patterns, which corresponds to the arrangement of the same on the pattern plate (Fig. 11). Horizontal and vertical lines, which are provided with identification marks, cross all the holes in the jig plate. The holes which are to be used in this special case as guides for drilling the necessary dowel pin or screw holes in the pattern plate are indicated by circles drawn in heavy. Thus, the holes II × and 8* are used for securing the globe valve body pattern, II + and III || for the body of the bib cock, and so forth. By placing the onion skin in such a manner over the drawing of the pattern plate, that its hole O corresponds with the center hole C of the latter, and OI and OH respectively with I^1 and H^1, it will be noticed that the outlines representing the patterns cover each other in both cuts. The jig placed in this position over the pattern plate, and secured to it by the pilot pins at O, OI and OH is used in this manner for drilling all dark lined holes in the right hand upper corner of the draw plate. This being done, the pilot pins are withdrawn and the jig plate is reversed and turned into the upper left hand corner of the pattern plate, just as if it were hinged at the line OI, the pilot pins are replaced into the same holes of the jig as before and in this position they will secure it to the pattern plate by entering its pilot holes C, I^1 and H^2. It will be observed that in this position also, and equally well, the outlines of the patterns in both cuts fall exactly together. The jig is used in this position as before, the same guide holes which were used in the first position in the upper right hand corner serve again as guides for drilling the second quarter of the pattern plate. Identically the same process is then repeated at the lower left hand and lower right hand corners of the plate, by first turning the jig plate around the imaginary hinge center OH, and then around OI.

In order to prepare the patterns to suit the above conditions, we proceed exactly in the same manner, by securing one-half of each separately, and always the one which has the dowel holes, at the previously determined place on the jig plate and drilling clear through them the holes which coincide with those drilled previously into the pattern plate. The second halves of these pat-

terns are then placed in position against the first (drilled) halves; they are prevented from moving sideways by their original dowel pins, and they may be held together by suitable clamps. These clamps are preferably made of a universal type which adapts them for use with all kinds of patterns, their lower portion being constructed in the shape of a frame which rests on the table of the drill press without rocking and which is adapted for fastening the patterns in such a manner that their parting faces stand parallel to the drill table. The half of the pattern which has been drilled first with the aid of the jig occupies the upper position in this clamp or drill frame, and the holes in this one will now serve as guides for the drill to drill the holes in the second half which stands directly underneath. Finally have the original dowel pins of the patterns removed and fasten all parts separately in place on the pattern plate by either dowels or screws, or both, which ever may be preferable and most convenient in your particular case.

If I may call your attention again to the drawings, you will observe that we have prepared the pattern plate in this manner with four complete sets of patterns; yet, we have used only two. The castings resulting from the use of these plates should be perfect as to match. The amount of labor required to withdraw the patterns from the sand is reduced to a minimum, additional time is saved by the use of a stationary gate or runner on the plate, and double the quantity of castings can be produced in this manner with the same number of patterns and in the same number of flasks. All this can be accomplished by making an effort of no longer duration than it took to describe.

If you have followed the above description carefully, you may have noticed that it is not necessary to have an individual plate prepared for each set of patterns. Yet I thought it better to describe this method of preparing pattern plates and patterns for plate molding in detail, than to leave room for any doubt or error. You can easily see that much of the time which it apparently took to get the plate and patterns ready for the molder, can be saved by providing the entire surface of the plate with dowel holes before putting it into use. This should be done with the aid of the jig and in identically the same manner as has been sufficiently explained in the foregoing. Thus, only new pat-

terns have to be prepared for the purpose, and all others, which once have been fitted, are easily replaced and secured to their correct positions on the plate, providing their dowel holes were promptly provided with specific numbers, letters or identification marks. The additional holes in the plate will not impair its working qualities, but they could be easily closed up with beeswax if objectionable. Finally, it is well worthy to note that each plate can be used in connection with all patterns within its range, and that it can be kept in continuous service, while the patterns may be changed at will, and as often as desirable.

While the above description may appear somewhat too extended, I assure you that a serious mistake would have been made had the subject been slighted merely for the sake of brevity. At the same time I will say in justification of my apparent digression, that my original subject has not been sidetracked. At first sight, it may appear, that the construction and the manipulation of pattern plates has but little connection with molding machines, but I hope that I will succeed in showing in the course of this work, that they are not only intimately connected with each other, but that they are in fact the principal parts of all molding machines. The lack of intimate knowledge of how to make use of them to the best advantage, the want of proper means to effect this purpose and the wretchedly little effort which is made to catch the right spirit of their nature is generally the reason why a molding machine becomes an elephant on the hands of a molder and an eye sore to its owner.

FIG.7.

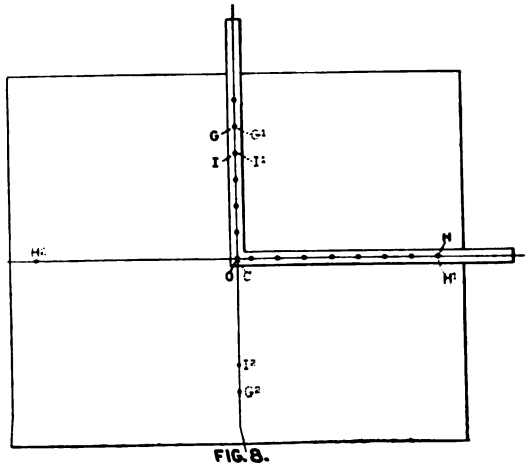


FIG.8.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

THE MOLDING MACHINE.

BY S. H. STUPEKOFF, PITTSBURG, PA.

FLASKS.

Talk to a foundryman about flasks and you will touch another sore spot. No wonder, for flasks are a continual drain on the exchequer. Founders will tell you that if it were not for the cost of flasks, there might be some profit in the business. They admit that they are are a necessity, but invariably think them an unavoidable nuisance, a source of constant annoyance, loss, and expense, and in fact the greatest evil of the foundry. It is often thought that every cent spent on the construction and maintenance of flasks is just so much money thrown into the gutter.

But luckily, all the opinions on this subject do not run in the same direction. There are many founders who have gone through it, who hold and prove that bad flasks give bad results, are false economy, and point to poor judgment. They argue, and justly so, that money spent judiciously for a good flask equipment, especially for a good set of stock flasks, and a liberal sum set aside and used for their maintenance, is a good investment. An expenditure of this kind is mainly a matter of first cost, and is fully justified by the results.

The founder who knows a good thing when he sees it, will also know how to take care of it. He will not permit his flasks to be abused and thrown out into the yard where they are exposed to the deteriorating effects of the weather. He will keep them under roof and guard them against all possible damage. Nobody will question the fact that bad flasks are more than likely the principal cause of loss of time and of castings. Yet how many are there who will anxiously try to save and stint in this direction? Give your molder good material, good facilities, and above all let him have good flasks, and you have a right to expect a good day's work, and that of good quality.

Good flasks are especially important in machine or plate molding. In fact, to insure good results from molding machines,

the flasks used must be practically perfect. They should be constructed so as to insure a firm holding of the molding sand. They should be made stiff, light, and durable. The flask pins should be accurately fitted. If flasks are made in sets, they must be absolutely interchangeable. When copes and drags are put together they should not rock or shake sideways. The pins should be firm and square with the flask surface; and while they must not bind on the other hand they must not fit too loosely.

Ordinary shop-made wooden flasks, such as are used in most foundries, are not likely to give good results in molding machine practice, but if carefully and substantially made, and perfect in all other respects, there is no reason why their application in machine molding should be absolutely condemned.

Iron flasks are always preferable, more especially because they do not shrink, warp, or get out of joint. Pressed steel flasks, if they could be procured, would answer still better. If wooden flasks are used, they should be provided with an iron ring, at their face, which ring should serve not only as a tie and alignment, but also as a base for securing the flask pins.

FLASK PINS.

Turned tapering flask pins give the best satisfaction in flasks for machine molding. Part of the pin is usually turned down to a square shoulder with a thread at its lower end, the cylindrical portion is fitted into a corresponding hole in the flask lug and permanently secured thereto by a nut. A better way is to ream tapering holes in the flask lugs, make the lower ends of the pins accordingly and drive them lightly into place. Thus, a few pins will answer for any number of flasks, as they can be removed as soon as the flasks are closed and clamped together. Greater care can thus be bestowed upon their production, as the increased cost is but a small item, and when not in use they can be easily removed from their sockets and bolts, flasks and pins can be easily and properly taken care of.

A convenient way to remove such taper shank pins is shown in Fig. 12. A piece of flat iron or a flask clamp is used as a lever by placing it between the lower end of the taper shank and

the rounded top edge of a fulcrum lug, which may form a part of the side of the flask, and which should be located one or two

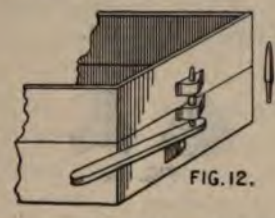


FIG. 12.

inches out of alignment with regard to the center line of the flask pin. A prolongation of these lugs may also form the handle of the flask. A slight pressure or a light tap with the hammer will loosen the pins from their sockets, whereupon they may be easily withdrawn. The B. & S. Standard is recommended as the most suitable taper for those taper shank flask pins. Accurate reamers are always obtainable in exact duplicates, and their use insures absolute uniformity.

It may not be out of place to caution against the maltreatment of the ends of these flask pins, which is bound to cause trouble and annoyance. There is not much likelihood to injure the pins if mallets of either rawhide, wood, lead or copper are used for driving them in or out. As an additional precaution, to protect them from injury it is desirable to have them case-hardened. Care should be taken that the flask pins do not spring or bend during the hardening process, if they do, this fault should be corrected before they go into service, for bent or sprung pins are unfit for use. Little or no trouble will be experienced with good tool steel pins.

It is common practice to arrange the flask pin lugs in such a manner that a space of about a quarter of an inch or more is left between them when the flask is closed. Thus, no attention need be paid to the small quantity of molding sand, which inadvertently collects and packs around the base of the pins while the flask is being filled, but which would otherwise form an obstruction in the closing up of the flask. These spillings must be removed if the faces of the lugs are on a level with the parting edge of the flask.

It is sometimes troublesome to close or open flasks which are provided with well-fitting round flask pins, as molding sand

or dust will unavoidably adhere to them. This difficulty may be overcome to a great extent by removing a portion of the cylindrical part of the pin by either flattening or grooving as shown in the cross section. Fig. 13.

FIG. 13.

Constant use of flasks of this kind will eventually wear out not only the flask pins, but also the sockets of their corresponding mates. They cannot possibly be kept absolutely clean, and the sand will keep on cutting until the defect must be remedied. It is an easy matter to exchange the worn out pin for a new one, but it is not so easy to correct the fault in the flask pin socket, unless, indeed, it was provided with a removable bushing in the first place. This, when necessary, can be replaced with the same facility as the pin. This is a point but rarely observed. To get perfectly satisfactory service out of a flask, it is nevertheless quite as important a matter as all the others which were mentioned above.

The makers of molding machines are undoubtedly very well aware of all the requirements, which are covered by the observance of these little details; they will appreciate their importance and must admit that they are essential to make their machines a success. Yet, to my knowledge these facts have never been mentioned. Is this information kept from the founder purposely, that he may not be scared from the purchase of machines? If he should be told all this he might in the first place think of the expense, and next that his molders cannot get used to refinements of this kind—which, by the way, is not a very creditable opinion. But, if he buys one or more of the machines offered he cannot help finding all this out before long, to his own chagrin. By that time, perhaps, he has made up his mind to throw the thing in the scrap pile, or, if he persists, because he knows that others have succeeded, he will be compelled to pay dearly for his experience. He could have had this experience in the first place, and at a reasonable price, had he been furnished not only with the machine, but at the same time with jigs, sample flasks, pins,

etc., and above all with necessary information to which he was justly entitled.

It should be taken into consideration, that not all founders, foremen and molders are expert engineers or machinists, nor can they be expected to be fully versed in all the intricacies of machine design, mechanical laws and movements. To convince them, and to demonstrate that machine molding is superior in every respect and more economical than the process of hand molding, in which line they themselves are experts, they need all available assistance and must be taught from the very beginning the principles of the construction of the machines, the scope of their utility, their application and the importance of accessories, and the essential parts in all minor details. Many failures to introduce the molding machine into foundries, to establish and to maintain their reputation as labor savers can be traced to the lack of intelligible instructions sent with them by their makers, and be it intention or neglect, the witholding of this information does more or less harm to all parties interested, and retards the world's industrial progress.

Journal of the American Foundryman's Association.

VOL. XI. JUNE, 1902. PART I.

SHOP CONDITIONS.

BY HUGH MCPHEE, BRIDGEPORT, CONN.

Taking the average foundry of the present day, generally speaking, we find conditions existing that are not creditable to either employer or the foreman in charge. A lack of interest, it seems to me, is the cause of this. The molder and apprentice, in my estimation, should not be held responsible for this, for we find that the improvements in all the other departments of great manufacturing concerns result in benefit to both employer and employee. Unfortunately these results are not met with in the foundry. Not that less work should be done, but ways and means should be provided to increase the efficiency of a shop. This, I think, can only be done by a combined effort on the part of the employer and his foreman to make the conditions such that the employee can have a place to work in that will give him heart and interest to do better than he ever did before.

Take the molder who commences at 7 A. M. As he strips for work, he hangs his clothes on a spike driven into the wall as near his floor as may be convenient. Many times these clothes drop to the floor, and no one bothers with them. Now he finds his flasks shook out during the night, but must tear the castings out of the sand, wet this down, get his shovel and temper his sand pile so that he can commence to mold.

By the time he is ready to mold a day's work he is played out, but by dint of practice and the necessity of doing so, he labors on with only one outlook before his mind—quitting time.

Now we know that things are usually severe enough to bear even with the best of conditions, for we all have had more or less of just this experience. Believing that a remedy is absolutely necessary, let us look at the conditions prevailing in the machine shop and the pattern shop. A machinist has a specified machine to operate, with helpers conveying the castings to be finished to him, keeping him supplied with material to perform

his share of the production. Producing finished work gives him an interest in it which is of benefit to his employer.

The same holds true in the pattern shop. The pattern maker has a bench to work at. His lumber is brought to the shop, laid down convenient to the saw and planer. He can get his material without any special exertion; in fact everything is placed for him in such a way that he has only to perform the work that his trade demands.

Now, why cannot we have some such conditions existing in the foundry. This is in itself a less desirable place to work in on account of the dust and dirt. Have a place for each man to hang up his clothes in, so that he can wear good ones. Have his floor in the same condition as the machinist has his—ready to begin work on. Let helpers prepare his sand pile so that he can commence molding and not act in the capacity of a laborer the first two hours of the day. Let his castings be shaken out for him, his flasks be fixed up. He can then put in eight hours molding instead of six, and get out superior work and much more of it.

May this effort to present the subject in a somewhat different light, result in awakening the interest of my foundry colleagues, and that some action be taken toward the improvement of the conditions surrounding the molder. Then the trade will receive greater recognition everywhere, and stand second to none.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

CORES AND CORE ARBORS.

BY EDWARD B. GILMOUR, MILWAUKEE, WIS.

In the upbuilding of our language it has been customary to give names to the things pertaining to science and art, such that on hearing them mentioned, a good idea of them is obtained, even though they have never been seen. Thus in foundry practice we ask what does a founder "found?" From this comes the subdivision into iron founder, brass founder, etc. Similarly the world "mould" conveys the idea of shaping something into a particular form as may be wanted. In speaking of cores one naturally recalls the well known quotation from Shakespeare, "Give me the man that is not passions slave, and I will wear him in my heart's core."

The core is a very important part of a mold, but in a great many cases is dismissed with the idea that all that is wanted is simply to ram sand in a box to the shape desired, and you have the core. This may be so, but unless the core is properly vented, that is proper channnels provided for the exit of the gases that are generated while casting, the result will be a bad casting. The gases will be forced through the surface of the core and blow the iron out of the mold. In many cases the core will go to pieces, and so you will readily see that core-making plays a very important part in the production of good castings.

Cores are made in different ways and with various materials. The usual method is to dry them, for when a core is thoroughly dried there is less liability of anything going wrong. There are other cores that are used "green" that is not dried, and must be made of a different material from that used for the usual dried core. When a boy goes to work in the foundry for the first time he is taught the art of core-making, beginning with very small cores, afterwards branching out into the larger ones. This is

the first work of molding, and all good molders are, as a rule, good coremakers.

It is usually the practice to make a core-box of the final shape desired, but in many instances guides or templates can be used to great advantage when only one core is required. All cores must have an arbor or rod. These arbors can be made exactly to fit the core in every particular. Take for instance the crown core of a marine cylinder, as represented in Fig. I. The

CORE ARBOR
FIG. I.

usual method is to use a portable spindle and a sweep which is made for the bottom part of the core. The thickness of the core is cut out of the sweep and fitted back with strips to hold it in place when the bottom part of the core is swept up. Or, as we might call it, the core box is made as you would build a regular loam mold. Fig. 2. The strips are then taken off and molding

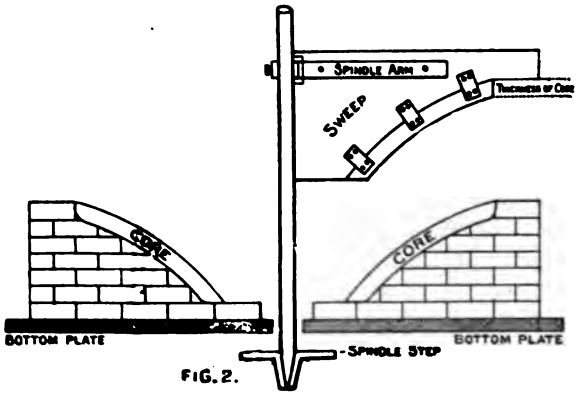


FIG. 2.

sand is rammed into the core-box and swept the shape of the top of the core. Now take a gate-cutter or piece of tin plate,

about four inches square, double over into a U shape and use this to cut out the mold to the desired shape, afterwards using a stamp in order to make the mold more regular. Also get a "Dauber" and insert into the mold every four inches apart, and get strong paper, cut it into V shaped strips to cover all over the mold. Fill the centre in with sand up to four inches above the top, with the usual gates inserted in order to run it. Straighten over the top and put a flat plate of the size required, on top of the sand, and bolt down to the bottom plate.

This is a very economical way of making difficult core arbors and can be utilized for any strength required. When the casting is made these arbors can be very easily broken out, on cleaning, and the iron used again as scrap.

The same kind of an arbor can be used in a great variety of work, such as the port cores of marine cylinders, and the cores of locomotive cylinders. I have used them to advantage and with economy, and personally brought the cost of locomotive cylinder cores twenty-five per cent. below the usual method of loose rods, besides having a better and safer core. The method adopted was to make a rough wood template in the shape of the core required, afterwards to make a mold the shape of the template, then cut out and stamp the arbor to the strength required, cover the mold with paper and fill over with sand. In making core arbors on this system they can be of any desired shape, no matter how intricate they may be. It is sometimes very desirable to make cores in green sand, especially when castings are very thin, as in a great many instances it would be impossible to get the core taken out before the contraction of the casting had taken place. Cores made in green sand are soft and yield readily to the contraction.

Another great advantage derived from the use of these cores is that they are very easily taken out and you can use the same material over again.

I at one time had a number of castings to make of the following description: A shell 2 feet by 2 feet 6 inches by 4 feet long and one-half inch thick. It can readily be seen that to use a dried core for a casting of this kind would be folly, as the casting would be cooled and fully contracted before the core could be taken out. The following method was adopted: An arbor was

made, as shown in Fig. 3, the end bars were made one inch deeper and were planed perfectly straight so that they rested upon the

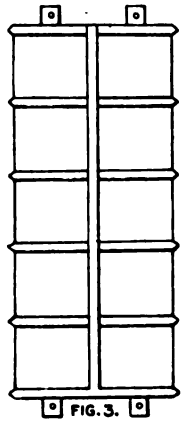


FIG. 3.

bottom of the core box. In the flask two bars were bolted the same distance apart as the bars on the arbor, so that when the core was placed in the mold the bars rested upon each other and made a very solid bearing. Holes were put in the lifting lugs in order to bolt the core to the bottom board, which had an iron strap screwed on the full breadth of the flask with holes right below the ones in the arbor. The object in having the bars planed off was that when the core was placed in the mold it would be perfectly square, as these bars in the flask rested upon the core prints of the pattern and an arbor of this design is so strong that it is impossible for it to twist in any way. If a green sand core should get twisted it is liable to crack, and should a crack occur in a core of this kind the casting would blow up when being cast.

In making a core of this kind it is good practice to put a sheet of newspaper on top of the cinders in order to keep down the pressure of the gases generated while casting. In making a green sand core of these dimensions there is a great pressure of gas inside of it, and unless great care is exercised in its production it is very liable to burst through the outer surface. The use of paper is suggested in order to keep down the pressure and expell the gas through the channels prepared for it.

Upon another occasion I found green sand cores of great

advantage. We had to make a large number of columns, having an 8-inch square core running clear through them. These columns were 14 feet long, and we simply made a box grate, Fig. 4. For the vent we had inch rods rammed in the ends of the

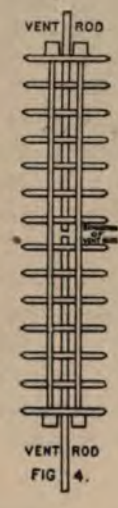


FIG 4.

grate. These rods were put in from each end right through the centre of the core as shown, the rods being about 1 inch apart at the centre, the object being to allow the gas as it is generated to go freely off. If the rods were continuous, the gas as it is generated would travel back and forward until the pressure would become so great that when it was ignited it would explode and would in all probability shatter the core, making a defective casting. The object in making this core in green sand was that when the casting was to be cleaned it was simply lifted on end with the crane and struck a few blows with a sledge hammer. The core came running out and the arbor was saved for the next one. Not only was there a saving in the cleaning of the casting but also in the material.

In foundries that a large number of pipe connections to make, and which entail a great expense in pattern making, especially as in the majority of instances, these patterns may never be used again. The principle that was adopted was to make

iron segments 3½ inches wide, the inside being the size of the core. A quantity of all sizes were kept in stock so that whenever pipe was ordered there was always the size on hand that was needed. In order to get the required shape there was made a rough wooden template of the size through the longitudinal section of the pipe. The first operation is to dig a hole in the floor in the shape of the template, the segments and flanges are next put into the hole and the template placed on top. The flanges and segments are arranged to the desired shape, the sand made up to the inside of the segments, which will be as a core box for the pipe when completed. The core arbor is next placed inside of the mold and the green sand core rammed up right inside in its place. Now match the other half segments and flanges on top of the lower halfs, so as to form the upper half of the core, but put the sand on the outside of the segments so as to form a pattern for the casting thereafter. Make the cope on top and when completed lift off. Then take away the top segments and cut the thickness between the segments. Lift out the core by the three points marked on Fig. 5, cut out between segments in mold and finish as usual.

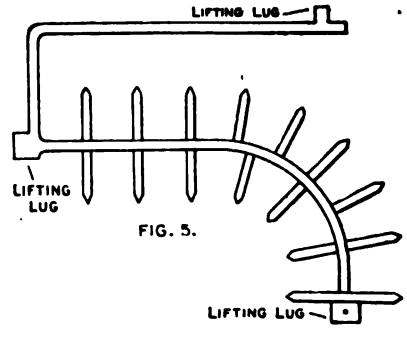


FIG. 5.

A core arbor made on this principle requires no anchor or chaplet below the core, but there must be one on top so as to hold the core in its proper place when the pressure is put on in casting. In setting the core arbor into the mold to make the core, it is necessary to put a solid bearing below the three lifting points so that when the core is put back into place there

will be no danger in crushing the mold.

The cost of producing pipes by this method is as cheap as if there was a solid pattern, and there is a great saving of material. There is no limit to the size of pipes which can be made by this method.

Another way which is very convenient for making special pipe connections, which are considered small, is to make a gauge as shown in Fig. 6; also a sweep as in Fig. 7. Make two half

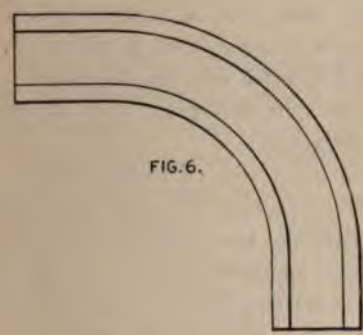


FIG. 6.

FIG. 7.

cores, and when dried sweep the thickness on each half. In molding lay one half on the follow board, ram up, roll over, and place the other half core on top; make the cope, and when completed take the core out and send back to core room in order to have the two half cores pasted together.

In making cores for straight pipes, such as water pipes, they are usually made upon corebars, or spindles as they are termed. Sometimes these bars are cast hollow, with holes dispersed all over them, in order to allow the gases to escape when casting. For small pipes ranging from 3 to 4 inches in diameter, a round, solid bar is used with grooves or slots running from each end so as to serve for the air passages. These bars are usually revolved by power, the bars having trunions on each end which fit into a bearing box. A cap fits over them so as to keep the trunion in place when in motion. Hay ropes are wound around the bar, and afterwards common black mud is swept over the ropes. This is termed the first coating. Thereafter the core runs upon a double rail into the drying oven and keeps revolving slowly

through it to the opposite end. It is taken out by the man who puts on the finishing coat. He in turn rolls it upon the same double track into another oven and it follows the same process of drying. When completed it is taken out and gets a coat of blacking while it is still warm.

I might go on and give a great many methods of making cores and core arbors, but the same in core making as in molding one has to be guided by judgment, experience, and circumstances, as to what promises to be the best method to adopt. The number of castings required must also be considered so as to be sure that whatever method is adopted that it will pay. It is here that the specialist gets in his work and produces castings at phenomenally low costs. This can, however, only be done when quantity is one of the main factors.

The question is often asked what size of outlet should be given in venting cores. The best practice is to get it as large as possible, for the larger the outlet the less liability for the passages getting closed. It has been maintained that an opening of one-eighth of an inch area is large enough for a cubic foot of core. I have in some instances had a smaller opening, proportional to the size of the core, for a vent passage, but it is not always good practice to have such small passages. When the outlets are very small it is not good policy to put many cinders into the cores as the more cinders present in a core, the more gas is generated. It is in cases of this description that the designers of castings can materially help to simplify work in the foundry, and if they were more conversant in foundry practice there would be more sympathy and respect for the molder, on account of the many difficulties he has to overcome.

The kind of material most commonly in venting cores is cinders. These are the best and the cheapest, and have a tendency to steady the pressure of the gas when generated, and allow it to pass off very easily. The arbors in the cores also make an excellent vent, for when the core is dried the heat in drying expands the rods and causes a continuous space throughout the whole core. In very sharp points in cores it is good practice to simply put plenty of rods without any vent passages whatever as the rods will be sufficient and are more safe.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

THE EFFECT OF MELTING STEEL WITH IRON IN THE CUPOLA.

BY H. E. DILLER, CHICAGO, ILL.

It is well known that melting steel with iron in a cupola adds strength to the resultant casting. But to what degree this is so, and the best proportion of steel to use are not so clearly understood. With a view of learning something more definite in regard to these two subjects; and also to see if it were possible to trace some connection between the percentage of total carbon in the iron, and the tensile strength, I have made the tests given in the accompanying table.

The tensile and transverse strength given, are the average of two, and in some cases three, test bars. For the tensile strength a 1⅛ inch round bar was used. The transverse strength was obtained from a one inch square bar placed on supports twelve inches apart.

The objects sought in the following classification is to have the silicon about equal in the tests of each set, the amount of the other elements being as nearly alike as it was possible for me to get them.

Tests Nos. 1 and 2 show comparatively little difference in the chemical contents, except in the manganese and graphite. As the manganese in No. 1 should be beneficial to the strength of the bar, the only way to account for the greater strength of the iron from No. 2 is the lower percentage of graphite, or the molecular structure resulting from the 25 per cent. of steel in the mixture.

Comparing Nos. 3 to 7 we find that the strength increases with the percentage of steel used, and the decrease of total carbon with the exception of No. 7. In this 37½ per cent. of steel was used, and the total carbon was less than in any other test, but it is weaker than either No. 5 or No. 6. This being a solitary

case it can hardly be used as proof that 37½ per cent. of steel is more than it is well to melt in a cupola. But test No. 11, which also contained 37½ per cent. of steel and more carbon, was only a little stronger.

Test No. 4 was considerably weaker than No. 5, but its higher percentage of sulphur with its lower combined carbon would seem to indicate that these bars were either cooled slower, or poured from duller iron than were the bars from No. 5, which may account for their being weaker than the No. 5 bars.

In looking at Nos. 8 to 11 we see that No. 9, although containing 12½ per cent. of steel is no stronger than No. 8, in which there was no steel. And No. 10 with 1.06 combined carbon, and 12½ per cent. of steel, gives less strength than might be expected. As these tests are so much lower in manganese than Nos. 8 and 11, it may be that their weakness is due either to the lower manganese or to the conditions of melting, which reduced the percentage of manganese so much more than in Nos. 8 and 11. The four charges each contained about .50 manganese before melting.

Nos. 13 and 14, each from charges containing 25 per cent. of steel, show a marked increase in strength over No. 12.

We find that all the tests from charges containing 25 per cent. of steel are stronger than those from the charges containing but 12½ per cent., with the exception of No. 5, which is stronger than two of the tests which had 25 per cent. of steel in the mixture.

The tests were made with pig iron, ferro-silicon and steel scrap, no cast iron scrap being used. This was done in order to better control the percentage of the elements in the iron.

In some cases when a large percentage of steel was added, it was necessary to use ferro-silicon to get the desired amount of silicon in the charge. To see how this and the steel mixed with the pig iron two tests were taken from No. 13, which contained 1,000 pounds of steel, 400 pounds of ferro-silicon (8.5 per cent. silicon) and 2,600 pounds of pig iron. The charge was tapped from the cupola into a ladle, and the tests taken at different times, as the iron was being poured from the ladle. The one sample contained 2.53 and the other 2.54 per cent. of silicon.

Two tests taken in the same way from No. 14, contained 1.07 and 1.04 per cent. of silicon. This charge was made up of

No.	Silicon	Sul.	Phos.	Mangan.	Comb. C.	Graphite	Total C.	Tensile Strength	Transverse Strength	Per Cent. of Steel
1	1.43	.047	.564	.82	.67	3 14	3.81	23060	2550	0
2	1.50	.065	.532	.33	.64	3.44	3.08	30500	2840	25
3	1.76	.062	.488	.53	.51	3.12	3.63	22180	2440	0
4	1.76	.139	.515	.57	.43	2.94	3.37	27090	2770	12½
5	1.77	.069	.339	.49	.56	2.87	3.43	32500	3120	12½
6	1.83	.100	610	.55	.51	2.44	2.95	36860	3280	25
7	1.75	.089	.598	.35	.74	2.12	2.86	30160	3130	37½
8	1.96	.104	.446	.44	.63	3.18	3.81	21950	2230	0
9	2.12	.037	.410	.26	.38	3.26	3.64	21890	2470	12½
10	2.16	.060	.315	.20	1.06	2 30	3.36	26310	2670	12½
11	1.97	.093	.470	.48	.57	2.83	3.40	32530	3050	37½
12	2.35	.061	.515	.56	.54	3 40	3.94	21990	2200	0
13	2.53	.104	.490	.54	.60	2.56	3.16	33390	2850	25
14	2.36	.064	.327	.24	1.08	2.15	3.23	31560	3200	25

1,500 pounds steel, 450 pounds ferro-silicon, and 2,050 pounds of pig iron.

Similiar tests from charge No. 2, which was made up of 1,000 pounds steel and 3,000 pounds pig iron, contained 1.50 and 1.52 per cent. of silicon.

These three cases offer pretty strong proof that the pig iron, steel, and ferro-silicon mixed thoroughly.

Although of a limited number, the tests given seem to indicate that 25 per cent. of steel will add about 50 per cent. to the strength of the iron; and 12½ per cent. of steel, approximately 25 per cent. The tests containing 37½ per cent. of steel were hardly as much improved in strength as those with 25 per cent. of steel, from which we may infer that the limit of the amount of steel it is beneficial to melt with iron in a cupola, is between 25 and 37½ per cent.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART

SOME METHODS OF INCREASING FOUNDRY PRODUCTION.

BY DAVID REID, BIDDEFORD, ME.

The success or failure of a foundry manager does not depend on his ability to give a correct chemical analysis of the material he uses, nor his ability to figure for his employer almost unheard of ratios in melting iron with coke, nor yet in his own unquestioned ability as a molder. The combination of the three, however, go a long way in contributing to his success in this "Progressive Age" of ours.

It is a progressive age, as we must all admit, with its developments in the arts and sciences. In our own industry, the molding machine has taken gigantic strides, though still almost in its infancy. From a business standpoint, this is also an age of competition that is keen and sharp at all times, and at periods becomes so bitter as to be criminal in its effects, and necessitates the intervention of the law.

Competition is healthy to any business, when carried on in a fair manner, and it is at the present time when you are in the market for work, that the production is of the most vital importance, for apart from the cost and sometimes taking precedence even over this, the question of delivery will often determine who shall have the contract.

Right here is where a manager makes or mars not only his own future, but possibly that also of the firm, for on his ability to turn out the maximum production at a minimum cost with the men and room at his command, lies the whole secret of success.

During the past year, we have received through our "Journal" splendid articles on various topics that incidentally touch on this matter of increasing production, prominent among which is the article on "Molding Machines" by Mr. S. H. Stupakoff of Pittsburg. The molding machine from the plain and exceedingly cheap but useful press to the latest creation of the automatic,

"which does everything but pour the molds," is the greatest factor the founder can use to increase his production, whether he is in the specialty or the jobbing line, and in the article referred to above, the writer has handled this subject in such a very able manner, that I simply endorse his statements, and draw your attention to some very good advice he gives at the end of one of his papers.

Sometimes, a foundry, while equipped with all the modern appliances for turning out work, finds itself unable to live up to its contracts, and the following method was employed in one, which, though not modern in all its equipment, yet competes successfully with those that are, in the general light, machinery work. Being part of a large plant for the manufacture of light machinery, there came a time when the other departments were compelled to run night and day, with the natural result that the foundry, already taxed to its limit, was unable to keep up the work for the machine shop. Part of the work was therefore given to another foundry in order to help out. This was most unsatisfactory to every one, except the other foundry, and the manager adopted the same system, with modifications, as the machine shop, namely two crews of molders, machine operators and laborers.

The day crew began work at 5.30 A. M. and worked till 5.30 P. M., with one hour for dinner, receiving twelve hours as compensation, while the night crew started at 5.30 P. M., and did not finish till 12.30 or 1 A. M., getting paid for eight hours. The crews changing about every week, payments being made every two weeks, their average time being ten hours daily. On Saturdays the men started one-half hour earlier, to avoid Sunday work.

Previous to this arrangement, the men had been receiving three hours extra as a premium for additional work, while the two cupolas, one small remodelled McKensie and a large one of the same type, were supposed to be at their limit, giving in two heats twenty-seven tons of a melt daily.

In the writer's opinion, the doubling of this amount of iron melted, which was accomplished and even exceeded at times, is the most creditable part of this method of increasing the production. The small cupola was used in the forenoon, being

timed to drop bottom at 11.45, and bringing down a melt of twelve tons. Five hours later a laborer "chipped" it out getting it ready for the melter and his assistant, who after eating their supper had this cupola ready for the blast at 9.30 P. M., when a second heat of seventeen tons or over was melted in the one cupola, making a total of twenty-nine to thirty tons every twenty-four hours from a cupola rated by the builders at four tons per hour.

The main heat of the day was in the large cupola, which seldom went under twenty-seven tons, this being arranged to get through at 5.30 P. M., there being one section of the shop that worked 10 hours straight.

This system of increasing the production was carried on most successfully for a period of seven months, until business became normal again, and at the end of that time the foundry was nearly three months ahead of the machine shop, which is an exceedingly good thing to have during the time for labor agitations of various kinds.

As stated before, the cupolas used were of the McKensie type and the height from bottom plate to bottom of charging door was only 9 ft. The daily consumption of fire brick used in patching was only eight on an average for the entire period of seven months, when the small cupola was relined to the charging door.

How about the molding sand you would ask, and my reply is that this was taken care of by pouring the front of every floor that was to be used at night, in the first or morning heat, and having laborers take out the castings and wet the sand. When the balance of the work was poured and dumped, that sand was placed one side leaving the cold sand ready to be used by the night crew.

In regard to the cost per pound of producing castings by this method, though not at liberty to give exact figures, I can assure you, that it was less than the six months preceding, when the men were receiving premiums.

Mr. R. C. Cunningham in his paper on "Foundry Costs" brings up a point that gives a glimpse at the possibilities for increasing production by the division of labor where it belongs. The steel works and some of the specialty foundries have to a

great extent solved this problem, and in the recent conference of the Iron Molders Union and the Stove Founders National Defence Ass'n, it was recognized by the molders that the general trend of industrial development is in employing skilled labor, as far as practicable, at skilled work. I am willing to predict that in the future, and how near for you individually, depends upon your managers to a great extent, that every molder without reference to the class or character of the work, will do nothing but produce, leaving the pouring, the dumping up of work, the cutting and mixing of the sand and all other laboring work, to unskilled labor.

When you reach the point where the molder starts in the morning to practice the art at which he has served a number of years' apprenticeship, and continues at that work all the time he is being paid for, then and not till then, will you have solved the problem of the greatest production at the lowest cost.

A number, how large I do not know, of you here to-day, run jobbing and general machinery foundries, and I venture to say that certainly 95 per cent. of your molders stop when the blast goes on, whether it gives them six or seven hours of molding time, and as all cannot pour first, the greater part of your crew are waiting their turn and doing nothing.

What matters it if you insist on their staying in the foundry till the whistle blows, do you gain anything by it, except the moral effect it has on the other departments, which of course is no small matter?

You might ask how the molder would take to this system, and though they appreciate the efforts in this line, in the Stove Foundries where it is all piece-work, yet in machinery work, might it not cause trouble? Having a large number of molders working under this division of labor principle, I can say that they are perfectly satisfied and think it the finest scheme yet devised, as they have no pouring or dumping to do, thus eliminating the hardest and hottest part of what formerly constituted their work.

The only objection, that comes from any one, is in regard to the pouring crew. But obstacles are encountered only to be overcome by the ambitious, and the men who do the pouring *may be only* laborers under the direction of a molder, trained for

that special work as you would train them for the molding machine. Or if you prefer it, they can be culled from your apprentices with the addition of a molder or two as leading hands, while a large majority of your molders keep the cost where it belongs by producing molds.

The dumping and cutting over the sand in the machinery shop where this system is in vogue, is accomplished by means of a night crew of laborers, fifteen in number, who take care of the work of one hundred and twenty men, in twelve hours.

That the pouring requires a certain amount of skill, is granted, for on that often depends the quality of the work, yet we have an instance right here in old New England, where laborers, trained of course, pour up the entire amount of work put up by the molders in a foundry handling nearly twenty-five hundred (2500) different patterns in a week, the weight in the casting varying from an ounce to 275 lbs.

The immediate result of this method of increasing the production was the saving of one day's wage all around, as the same amount and over in fact, was produced in five days, where before with the same crew it took six.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

BRASS MELTING.

BY CHAS. VICKERS, CHICAGO, ILL.

Compared with steel or iron, it is an easy matter to melt brass. On a small scale, it is frequently melted in an ordinary heating stove, or on a forge, (in the latter case, however, a temporary furnace must be formed of brick, and the crucible coked up therein). Such crude methods though, are suited only to the amateur, or where a small breakdown job is needed in a hurry by some firm not having the ordinary melting facilities.

When brass is melted on a large scale, the furnaces are a very important part of the plant, and it pays to do considerable thinking and figuring before building them. The character of the castings to be made, must always influence the size of the furnace, as small furnaces are much more economical for the production of small and light castings than large ones. This is a thing not always considered however, so that it is a common sight to see a "30" pot put into a furnace intended for a "hundred." The coal dealer may never kick at this, but his debtors often do at the size and frequency of his bills.

Here then is one point in brass melting, whatever the size of the furnaces, three inches of solid fuel around a crucible will do as much work as six, and is more economical in fuel, labor and metal.

The fuel saving is apparent without a thought. The labor saving requires a little more effort to perceive. We must consider the extra shovelling and "poking down" required by the larger furnaces, while as to metal saving, some people may not see that point at all unless it is explained. Therefore, the larger the fuel surface, the greater the heat, thrown towards the furnaceman when he removes the cover, and the greater the temp-

tation to stand away off, and "peg" the metal at the crucible when the foreman isn't looking.

Some melters become quite expert at hitting the crucible, and most of the metal charged, finds its way therein. But they can never overcome the splashing when a chunk drops into the liquid contents of the pot, and most of these splashes are lost in the fuel, and they are metal. So this is bad practice, and generally costs more than the loss of fuel. Another little point to be considered in economical melting, is never to charge up a pot, unless one is reasonably sure that the molds are going to be ready when the metal is, because it costs money to "hold" a pot in the furnace, as is frequently done. Then again the much abused crucible will wear away as much or even more, when only half filled than when filled.

And still again, never build or allow your furnace to become "barrel shaped," high-faluting theories to the contrary notwithstanding. A straight wall is always the best.

As far as we have gone with these remarks, no particular style of furnace has been recommended as being better than others, because most brass-founders have their own theories in this respect, and although they may differ in minor details, most solid fuel furnaces bear a general resemblance to each other, so much so that there is another defect so serious and so universal, that lots of good strong language might with advantage be used thereon.

Not that there is any intention of using strong language here, we will leave that in the shop mixed with the gas that causes it, and in a few mild words explain the trouble, and suggest a remedy. As before mentioned, this trouble is caused by gas, the products of combustion being too often driven into the shop, polluting the atmosphere to such an extent, that the health of the human beings employed therein is seriously endangered. For molders are human beings, although some people seem to doubt it and think that anything will do for people employed at such dusty, dirty work.

Many founders imagine that when power is applied to furnaces it is impossible to carry off all the gases, and so it is, with flues adequate for natural draught, but when the air supply to a furnace is increased by the application of a fan beneath the fire

the flue area must also be increased, unless the same was abnormally large before the fan was applied.

So if there is gas in your shop your flues are too small, the remedy is to enlarge them, do not go to the trouble of cutting holes in the roof or to the expense of placing ventilating fans, which you will find are failures so far as removing the gases is concerned. And right here, let me impress the fact that it is not always the main flue which is faulty, most founders make this generous in size, turn your attention to the flues connecting each furnace to the main flue. Your foreman may pooh-pooh the idea and advance all kinds of theories to the contrary, but do not listen to him, he needs educating on this point and see that he gets it, or get a new foreman.

There is no evading the fact, that if a flame is driven from beneath the covers of furnaces, the products of combustion are being driven into the workshop instead of through their proper channels into the outer air where they are harmless. In place of driving air through a furnace, in some few cases the fan has been placed in the flue and by exhausting the air therefrom creates a strong draught through the flues, the furnace being operated the same as natural draught, that is with open ash pits.

With this system a high chimney is not necessary, and the atmosphere of the shop is entirely free from contamination by the products of combustion. It possesses one disadvantage to careless people, and that is the flues and their connections must be kept in good condition, should they be permitted to fall into decay, the melting capacity of the furnaces would diminish in proportion to the air leakage.

For this reason, unless exceedingly well built, brick flues are not so well suited to this system as are iron ones, because the average brick flue, built by the average brass melter or his foreman, is never built as well as the poorest bricklayer would do it, and consequently rapidly crumbles under the racking effects of expansion and contraction.

When sheet iron is used for brass-furnace flues, they are best when made circular in form, with rectangular cast iron connections to each furnace, the main sheet iron flue must be suspended and not allowed to touch a wall or any non-conductor, if the air has free access to it the flue will rarely become red hot.

and will consequently give good and economical service.

If the heat radiated from the flue troubles the melter, which it probably will, do not sheathe it in asbestos, or you will soon have nothing but an asbestos paper flue and a poor one at that, but hang a curtain of asbestos in such a manner as not to touch the flue, but still shield the melter.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

ECONOMY.

BY P. R. RAMP, SCHENECTADY, N. Y.

Economy is something that is essential in carrying on a business of any kind. The foundry business is no exception to the rule, and at no time is there an opportunity for so much thought and study along this line in our industry than now.

In our efforts to cut expenses we sometimes begin at the wrong end, and as the old saying is "We spend a dollar to save a cent." During my experience as a foundry man, I have heard many men express their views as to cheapest methods of production.

While I have often been able to profit by suggestions, I have listened to some arguments which were amusing. In order to produce good work, work that must come up to given specifications, we must use good material. I have a personal dread of cheap blacking, cheap foundry flour, poor molding sand, soft coke, poor iron, etc.

A poor grade of material can be purchased for nearly one half the cost of a better and more suitable article. Yet it is generally economy in the end to purchase the best, as the reduction in loss of bad castings will in many cases exceed what is gained by the reduced price of the cheaper material. The following are some of the materials that are often brought to our notice as something that can be bought cheaper and will save us money. For instance a foundry flour at one half what the regular supply is costing us, yet when a carload is received we find it is necessary to use about twice as much as we take of the old flour to do the same amount of work. This is detrimental in more ways than one.

In making cores or dry-sand molds, the more flour is used in the sand mixture, the more gas there is generated. And the more vegetable matter that will produce an excessive gas, the

greater possibilities there are for a cut, scab, or a blow, which results in a bad, or dirty casting.

The greater the amount of flour we are forced to use in order to make strong cores or molds, the more they will swell while drying. This causes them to vary in shape and size.

Another item is "plumbago," "blacking" or "dry sand facing." We may be paying 4 or 4½c per pound for a lead that is doing good work and pealing the castings in a very satisfactory manner, when along comes a "supply man" and induces the purchasing agent to buy a car-load of a cheaper lead, say for 2½c per pound. This lead he will probably say, is used by several large concerns, whose product we know is all that could be desired. Here is where impractical man is lead astray. He does not consider what quality of sand the parties referred to are using behind this lead, perhaps this is a good open sand that would do the work nearly as well without any lead or facing. We try this lead on our work, our sand is close and contains matter which promotes the formation of gas, and this creates in the molted metal an uneasy motion while it is being poured and after the mold is filled before it solidifies. This action of the iron causes additional wear on the surface of the mold and the cheaper grade of blacking will wash and rise to the surface, thus producing a dirty casting.

Poor molding sand is a great draw-back. I have in mind a firm that obtains a very poor grade molding sand from a supply house some 200 miles away, when better sand could be dug within one mile of the shop. The only objection is, this good sand cannot be shipped in carload lots, but must be hauled by wagon loads, which is really preferable as it is an easy matter to reject the wagon load of poor sand and receive a better grade from the same wagon an hour later. But 'tis no small job to be compelled to work up three or four carloads of inferior material.

Poor coke causes much trouble. I know of a large concern in the west who use a very cheap grade of soft coke for melting purposes because it can be purchased at about $3.00 per ton less than good seventy-two hour coke would cost. They claim a saving in this method, but it is my belief that if they should consider the extra time consumed in melting and the castings that find their way to the scrap pile on account of dull iron, they would

realize that there is more economy in using a good grade of coke.

The same is true where one blower is used to furnish wind for two cupolas, and the capacity of the blower is but a little more than is required for one cupola. This makes it necessary to put the blast on at say 12.40 or 1 o'clock, and with two cupolas one 60 inches and one 48 inches diameter, it is a good job to melt 60 tons by 5 o'clock, which means 15 tons per hour for two cupolas. Now, if an independent blower were used for each cupola, with the proper tuyers location, the time consumed in melting could be cut nearly in half. This would make it possible for the molder to work up till 3 o'clock P. M. at molding, instead of beginning to pour off at 1 o'clock, which would mean two hours more. This would in a short time pay for several new blowers.

When we refuse to give our molders good flasks and good patterns to work with in order to save, we often loose more in bad work than it would take to build new patterns and flasks, to say nothing of the delays caused by failures of molders to make good work which may be directly traced to poor rigging.

To those who have always considered the building of flasks, an unnecessary expense, and have practiced the most rigid economy in regards to them, I want to say that good molders are hard to get and expensive. In shops where the proper appliances cannot be secured, they are hard to keep. But if we make the equipment of the foundry a personal study, and build our flasks, patterns, etc., in a manner that will simplify the work regardless of first cost, the question of good molders will be settled. With all conditions as they should be and the work and methods made easy it is possible to develop good molders out of what men we have in our own shop or even out of men that have never handled a rammer or shovel. I would prefer the latter as I believe there is much more economy in teaching a green man how to mold and paying him for scrap castings for a couple of weeks, and later receiving a fair day's work from his floor the year around, than there is in compelling a molder who has worked at the trade all his life to work in a different manner than he has been accustomed to.

The idea of economy with reference to pattern making is

in some cases a delusion. For instance it is more expensive to give a large gang of men one locomotive cylinder pattern and have them ram and finish two or more a day, than it would be to make two or more patterns and let them make one a day each. Two molders will accomplish more in a day than one half of what four men will accomplish on the same job with only one pattern. Besides this, much better work is the result of placing fewer men on the job. Hence where we have a number of castings to make in a rush, it is cheaper to build an extra pattern than to crowd too many men on one pattern.

In making iron flasks for locomotive cylinders it is economy to make separate flasks for the different sizes, where there is any great variation. It is false economy to try to use one large flask for all sizes. The reason is plain enough. On the small ones the same amount of labor is required to ram it up as on a large one when one large flask is used. And in drying the mold double the amount of fuel and time is required, to say nothing of the danger of the large body of sand saging and causing the mold to loose its proper shape.

There are many other things that could be mentioned which cause much waste, such as insufficient dry sand and core oven capacity, crooked core plates, improperly constructed patterns, system of handling melted iron, casting, sand, flasks, etc.

The different items I have made mention of in the above are not new to foundrymen. Although we all realize that these things help to increase the costs of production, there are many foundries to-day where just such conditions prevail.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

FOUNDRY COSTS.

BY R. C. CUNNINGHAM, HOLYOKE, MASS.

At the annual meeting of the American Foundrymen's Ass'n held in Buffalo a year ago, I presented a paper on "Foundry Costs." The ground I took at that time was that we were doing a large amount of work in our foundries which only increased our costs and did not increase our production, this unnecessary work being due to badly made and worn out patterns. The article was severely criticized by pattern-makers and others in trade journals and by personal letters. One man went so far as to say that the principal reason that foundrymen were not consulted more in the construction of patterns, was that very few could tell by looking at a drawing how a pattern should be made, and during his twenty-five years experience as a pattern-maker he had only met one foundryman who could read drawings intelligently. It was claimed that the paper had a tendency to create a bad feeling between foundrymen and pattern-makers and there would be constant wrangling as to how patterns should be made. I certainly had no intention of saying anything to belittle the pattern-maker or to provoke discord in any shop. I made the statement at the time only in the interest of the foundrymen, and I feel to-day that I am backed by a large majority in what I said.

Shortly after the convention I had an occasion to visit a prominent concern. In conversation with the manager he told me that he thought my paper would do good, and wanted me to go through his works and tell him just where he could save money. He further added, "I think we are about up-to-date, but am willing to learn." I went into his foundry and in observing things my attention was attracted by a molder standing ap-

parently waiting for something. While I was watching him the workman next to him passed him over his rammer. He took it and went to work. Upon investigating I found that these two molders had only one rammer, one shovel and one No. 4 riddle. Neither had a fine riddle, brush, pail or bellows, nor in fact any of the tools that are usually furnished by the company. They had quite a number of helpers in the shop. They did not give each of them a shovel. I spent the greater part of a day about the shop carefully observing the way the place was managed and I think I am safe in saying that 10 per cent. of the men did not have proper tools to work with and depended on borrowing from the other men or upon what they could pick up about the shop.

As I was leaving the manager called me into his office and inquired if I saw anything I would have different. I told him I thought there was some things that could be improved upon. He wanted to know what they were. I told him of the things I saw in the shop. He thanked me and said "I will look into it and I will write you." This happened about 10 months ago. I had forgotten about it when a few weeks ago the following came to me:

"You will remember spending a day at our works several months ago and of expressing yourself upon how you found things in the foundry.

"The next day after you was here I went into the foundry to find out the truth of your statement and I will have to admit you did not half tell it. I went into the foundry and stayed there over a week and I will say candidly I do not see how the men could do as much work as they did. In a few days every man had his supply of tools marked with his number. I stopped the molders waiting around in the morning. I had all their patterns and flasks on their floors by seven o'clock. I have the flasks fitted before the job comes into the foundry. The molders work no harder than they did before, but we are turning out more castings and they are much better. Our expenses remain about the same, lower if anything, which shows a reduction in the costs.

"The statements you made in your paper before the American Foundrymen's Association last year were facts. Our foun-

dries are neglected. We should pay the same attention to them that we do to our machine shops.

I sincerely hope you will give us another paper on the same subject this year."

This letter comes from a man who thought his foundry was up-to-date, and I have no doubt that there are many more of the same mind. Now I wish that every foundryman present at this convention, when he returns to his own home would go into the foundry and do as this man did, stay there a week or a month if necessary (it is a good healthy place to stay) and just take notice of the patterns that come into the shop and see if the molders have the proper rigging.

See that there is no waiting for anything. Give your molders a chance and you will be surprised at the results. Now I wish every foundryman present to-day would try this and at the end of three months write me the results, no matter what they are I would like to know how you found things in your shops. Those of you who are about your shops daily have no doubt seen and corrected every thing of this kind found there, but those of you who walk through your foundry only occasionally are the ones that I want to take this to heart and bear in mind that the little annoyances are where the time is lost. They may seem small in detail but are large enough in the aggregate to increase the cost of your castings. The time when we can get more than a fair day's work from a man has gone by and to-day every foundryman must keep close watch on his costs and production or he will find the balance on the wrong side of his ledger. In my opinion his only hope is to devise ways to do his work with more unskilled labor. By doing this he will not be dictated to, but will have a chance to get more benefit of his brain work than is now accorded to the employer of skilled labor.

There is one fact that we must not close our eyes to, and that is that the tendency of organized labor is to keep the production down to the lowest possible point, and at the same time increase the minimum rate of wages. Now with these cold facts staring us in the face we must watch very carefully and see that no work is done that we get no returns for. An hour or two spent on a badly made or worn out pattern means an increase in our cost, and does not increase our production, and

in order to overcome this we must figure and scheme to have things so that the moulder can turn out more work. It is an increase in our production without any increase in our cost, is what we must aim for. To do this we must study every pattern, and if we can, by making changes, make a mould any quicker, we should not delay a single day in doing so.

I want to give you one illustration on this point. We have at our works a pattern for a 16" steam piston ring. During the past twenty-five years the company has made thousands of these rings. They were moulded in the usual way. The pattern was made about one inch wider than the casting wanted, to be able to secure it on the face plate while turning. The ring is then cut off the desired width, and cut into four segments. The actual cost of labor on one set of these castings when they were ready to put into the cylinder, was seventy-five cents. The casting in the rough weighed twenty-three pounds. The finished casting weighed seven and one-half pounds. The waste piece cut from the ring, that went into the scrap, weighed six pounds. Nine pounds went into turnings. I expended three dollars and seventy-five cents on a new pattern and plates, and am now putting these same castings into the erecting room for four cents a set, besides the saving on the iron. I am saving seventy-one cents on labor on each set of castings. The company makes probably five hundred set of these rings a year, including the new work and repairs. The saving on this job alone amounts to three hundred and fifty odd dollars. A half dozen jobs like this would pay the salary for a good man for one year.

I do not claim that every job can be put on a machine on plates and the same results obtained, but even if we can get an increase in our production of 25 per cent. without any increase in our expenses, it is certainly worth trying for. Our company has put on during the past year over two hundred different patterns on plates, and on none of them have we made anything less than 50 per cent. saving. Any foundryman is welcome to come and inspect our patterns. We have no secrets about our shop. What we have learned by experience we are willing you should profit by if you wish.

An amusing incident happened at our works a short time ago. A foundryman was visiting our shop and I was showing

him this same pattern which I have mentioned here. After looking it over carefully he said: "It is a very fine idea, but I fail to see where you get any credit for it. According to your own statement you have cut down your production about two-thirds, now, unless your firm does different from any other you only get credit for what castings you turn out, where you formerly got credit for 23 pounds of castings, now you only get credit for 7½ pounds. It looks to me as if you were helping the machine shop at the expense of the foundry." I told him I was working for a firm that gave credit where it was due, and I think that every company should let their men understand that any improvements gotten up to reduce the costs or increase the production would be liberally paid for. It should be the aim of every foreman to encourage this among his men, particularly among the younger class. There is nothing that encourages a young man as much as it does to ask his opinion. We must remember that from among the young men we are to find our future foundry managers, and when they take the burden from our shoulders let us have the satisfaction of feeling that we exercised our ability to its fullest extent in filling up those dangerous pitfalls and removing as far as possible the stumbling blocks from their paths.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

THE METALLURGY OF THE CUPOLA.

BY H. E. FIELD, ANSONIA, CONN.

Boston brings to our minds thoughts of art, education and culture. We have shaken the foundry dust from our clothes and have come down here with a feeling of relief at having for a day or two escaped the worries and vexations which are inseparable from the foundry business. It is, therefore, with considerable temerity that I undertake to carry you back in thought to that part of the foundry which is the centre of most of our troubles, viz., the cupola.

I have no ideal cupola to bring before you, no improved wrinkle of center blast, steam melting, or ozone generator. I shall devote all the time you have so kindly placed at my disposal to a study of the effects of melting upon iron, and upon the metalloids therein contained. Numerous contradictory statements concerning this subject which have appeared in recent books and journals, together with several requests for information in regard thereto, have led me to choose this somewhat technical topic for my paper.

The quality of cast iron depends, to a great extent, upon cupola practice. The best of pig iron can be changed into inferior cast iron by poor melting; while an inferior pig may, by judicious melting and mixing, be used in high grade castings. There are hardly two cupolas in existence which work under exactly the same conditions; with the same sized tuyers; the same amount of blast; with equal height of tuyers from cupola bottoms, etc. For every variation in cupola arrangement, there is a variation of the effect in melting iron. The greater the difference in the cupolas, the greater will be the variation in the melted product. Pig iron and coke merchants frequently find

that two firms engaged in exactly the same line of work and using the same iron and coke, get very different results. Let us take as an example an experience which the managers of a certain foundry had with coke. They had used for a number of years a standard brand of Connellsville coke, and their cupola had been so arranged as to give the best results with this coke. The agents for another grade of coke, of a much lighter nature, finally persuaded them to try a car of their coke. After carefully ascertaining that a neighboring foundry was having excellent success with the lighter coke, they bought a carload. The first day it was used the trouble began and continued to such an extent that no more of that coke would be taken as a gift, and the last of the car was worked up, mixed with one-half Lehigh broken coal. Upon inquiry, the cause of the differing results obtained by them and by the neighboring foundry, which was using the same light weight coke with such excellent results, was found to be this: In their own cupola the distance from the tuyers to the sand bottom was but eleven inches, while in the cupola in which the lighter coke was being used so successfully, the distance was twenty inches. The tuyer area in the former was but one-half that of the latter, while the pressure in the former was greater by four ounces. This needs no explanation to one familiar with cupola practice.

Turning from coke to iron we find that the percentage of loss or gain of the metalloids or impurities varies with the height of tuyers, size of bed, melting ratio, the size of the tuyers, pressure of blast, amount of flux, and the method of fluxing. When pig iron, in the course of melting, comes in contact with the blast, and is acted upon by it, certain of the metalloids are burned out of the iron. This is true in all cupolas. The amount burned out increases with the amount of air forced into the cupola by the blower. In the same cupola, and under the same conditions, irons varying in composition will lose different amounts of impurities. As the melted iron, freed to a certain extent from some of the metalloids, passes through the incandescent bed of coke or coal, it absorbs new impurities from the bed. The amount absorbed varies with the cupola practice. From a heavy or deep bed, other conditions being equal, more impurities will be absorbed than from a light or shallow bed.

The temperature of the iron at this time has a decided effect upon the amount of metalloids thus taken up by the iron, as does also the amount of flux used. With a hot running cupola and a large amount of flux, little sulphur will be absorbed by the iron, while a large amount will come off with the slag.

There has been much discussion in the last year or two as to whether certain of the metalloids lose or gain in passing through a cupola. The great variation in the results obtained by reliable experimenters has led to a general belief that there is no fixed rule which can be followed in figuring these cupola losses and gains. This idea, however, is incorrect, as I shall try to prove by taking up each metalloid separately.

SULPHUR.

Under ordinary condition, iron melting in a cupola takes up sulphur from the fuel. The greater the percentage of fuel, and the greater the percentage of sulphur in the fuel, the greater will be the amount of sulphur absorbed by the molten iron. The ratio between the total amount of sulphur present in the fuel and the amount absorbed by the iron is dependent upon three conditions, first, the kind and quality of flux used; second, the temperature of the iron; and third, the composition of the coke and iron. A proper quantity of flux in a hot working cupola will take care of a considerable amount of sulphur. The sulphur present in the fuel as a sulphuretted hydro-carbon has no appreciable effect in increasing the percentage of sulphur in the melted iron. This accounts for the fact that many foundries melting with coal obtain castings with a lower percentage of sulphur in proportion to the amount of sulphur in the fuel than do foundries melting with coke. The greater the amount of manganese in the iron, the less sulphur will the iron absorb; and it is possible in cases of very high manganese iron for that iron to lose sulphur in melting; the sulphur passing off as manganese sulphide with the slag.

SILICON.

In passing through a cupola iron always loses in silicon. The amount of the loss depends upon two conditions; first,

upon the amount of oxygen brought in contact with the metal in melting, and second, upon the composition of the iron as it goes into the cupola. In giving the amount of silicon lost in passing through a cupola, authorities generally mention a fixed amount. This may have been true concerning the grade of iron with which the writers were familiar. But it would be wholly untrue concerning other grades. The greater the amount of blast, the more silicon will be burned out. The higher the percentage of silicon, the greater will be the percentage of loss in passing through a cupola. (By percentage of loss, I mean the ratio of lost silicon to the original amount of silicon in the pig). An iron running four per cent. in silicon, will lose up to twenty per cent. of its original amount, while the loss in an iron running .2 of one per cent. is hardly perceptible. This variation in the loss of silicon is accounted for by the fact that the lower the percentage of silicon in the iron, the greater is the affinity of the iron for that silicon, and the more difficult will it be to oxidize it; while on the other hand, the greater the amount of silicon present in the iron, the less will be the affinity and the greater the amount oxidized in melting. The percentage of carbon in the iron has a great deal to do with the loss of silicon in melting. This, however, will be taken up later under the consideration of carbon.

PHOSPHORUS.

A very slight amount of phosphorus is absorbed from fuel by iron in melting. It is practically, however, a constant quantity, the small increase being proportional to the amount of phosphorus in the fuel.

MANGANESE.

Manganese loses in passing through a cupola. Its action is that of a protector from oxidation and the amount lost in passing through a cupola depends upon the amount of blast and also upon the percentage of sulphur in the fuel. The greater the amount of air forced into the molten metal the more

manganese there is lost as an oxide. The greater the percentage of sulphur in the fuel, the greater will be the percentage of manganese passing into the slag as a sulphide. Manganese is not united with iron, as a compound, it is rather alloyed with it, having practically no affinity for the iron.

CARBON.

I have left this element until the last for several reasons. Principally, however, because its action is understood less than that of the other elements which we have to consider in connection with melting iron. Carbon is really the life of cast iron. Various articles and papers have been written and much discussion has ensued in regard to the effect of melting upon the carbon in iron. Some say that it gains, others that it loses. If the founder is to be able to control his mixtures by chemical analysis, he must settle this question for himself. The articles written upon this subject are wholly misleading. In the early part of 1900, there appeared an article in the "Machinery," written by Mr. J. E. Johnson, stating that iron lost carbon in remelting. This brought a reply from Mr. Thos. J. West in the following number, in which he contended that iron gained carbon in melting. Mr. West presented a record of the remelting of the same iron five times. In every case the iron gained in carbon. In a recent number of the "Foundry," Mr. W. J. Keep, in answer to a question stated as a positive fact that iron lost carbon in passing through a cupola. These opposing statements from authorities on mixing iron, can but discourage anyone who is attempting to learn from the writings of others the changes which iron undergoes in melting. A few weeks ago the following was referred to me by a foundry foreman. In order to determine the loss and gain in impurities in melting in his cupola he melted a quantity of No. 2 iron. He had the pig and the resultant casting analyzed and figured the differences. He then remelted some of the scrap from this heat alone. He had this iron analyzed and figured the change in carbon, etc. These two results were sufficiently conformative to allow him to figure that his cupola lost ten per cent. of the carbon in remelting. Sometime afterwards, having occasion to make castings which

required a very hard grade of iron, he had these casting analyzed and found that instead of losing ten per cent. of the carbon, his iron had gained in carbon in passing through the same cupola. It was a case of Mr. West and Mr. Keep illustrated in the same foundry. In the experiment of Mr. West, spoken of above, an iron running below one per cent. in silicon was used, and this iron gained in carbon. In Mr. Keep's stove plate work, iron running high in silicon is invariably used, and such iron will always lose carbon in melting.

Iron may both gain and lose in carbon in passing through a cupola, and whether the gain or loss predominates depends, first, upon the original composition of the iron, and second, upon the conditions or method of melting. An iron while passing down the cupola has a portion of its carbon burned off, the quantity depending upon the amount of blast and the time which the iron consumes in passing through that zone of the cupola, where the oxidizing influences are at work. After having a portion of its carbon removed, the molten iron comes in contact with the incandescent coke in the bed, and from this it absorbs carbon. The hotter the iron, the larger the amount of fuel, and the longer the iron remains in contact with this fuel, the more carbon will it absorb. If the amount of fuel is sufficient, the iron may absorb more carbon than it loses in passing the tuyers, and thus the iron will have gained in carbon. If, however, the blast is heavy and the ratio of fuel to iron small, the iron will lose more carbon in passing through the oxidizing zone than it can possibly pick up from bed, and thus the iron loses in carbon. These two conditions are at work every day in our cupolas. Melting with low blast and high percentage of coke will cause a gain, in carbon, while the high blast and low percentage of coke will cause a loss of carbon.

The original composition of the pig iron will have much to do with the loss or gain in carbon. An iron made at the blast furnace with a large percentage of fuel will be high in carbon. This if melted in a cupola with a small amount of fuel, will lose in carbon. While a pig iron low in carbon, made by a blast furnace using a small allowance of fuel, will, when remelted in a cupola with a relatively large amount of cake, gain in carbon. A low carbon iron, then, will tend to gain in carbon, while

a high carbon iron will tend to lose in carbon in melting in a cupola.

There is one more factor which we must consider in discussing this loss or gain of carbon in cupola practice, and that is the effect or rather the relation of silicon to carbon in this process. I have said that low carbon iron gained in carbon. Let us now qualify this statement by saying that a low carbon, low silicon iron, will gain in carbon. Carbon and silicon, although they are analogous elements in many of their properties, have always been considered to be almost opposite in their action on cast iron. The facts of the case are, that their actions are almost identical, although the results are different. Pure iron we know will absorb carbon up to 6.67 per cent., while it will absorb silicon up to 23 per cent. One part of carbon then is about 3½ times as effective on cast iron as is one part of silicon. We find this ratio to exist in our pig and cast iron to a marked degree. For every rise of 0.1 per cent. in carbon in our pig iron made under the same conditions, there will be a corresponding decrease of 0.35 per cent. in silicon, and vise versa. This applies in the same manner to our cupolas. When we melt a pig of say 3 per cent. total carbon and 1 per cent. silicon, we would expect under ordinary conditions, a gain in carbon. If, however, we melt a pig of 3 per cent. carbon and 4 per cent. silicon, we are sure, under the same conditions, to find a loss in carbon. Iron in the melted state may be thought of as a solution in which carbon and silicon each reduces the power of the iron to dissolve the other.

We have found then, that a small percentage of fuel, high blast, high carbon, and high silicon tend to cause iron to lose in carbon, while low blast, large percentage of fuel, low carbon and low silicon tend to cause iron to gain in carbon in melting.

When we consider the great variety of iron in use in foundry practice, and the divergency in cupolas, we can readily understand that no hard and fast rule can be laid down for all cases. Every foundryman must find out for himself, in his own cupola, and with the brands of iron which he uses, or else he must obtain his knowledge from someone whose experience is similar to his own.

Are our cupolas so arranged as to produce at the least cost,

the best iron for our work? Are we, in order to save a few cents, running them with the least fuel possible, and paying out at the same time, dollars to obtain the superior grades of iron necessary when iron is melted with little fuel? Are we melting with heavy percentages of fuel, and then adding limestone to reduce sulphur, and steel to reduce carbon? Are we using high silicon to soften, when it is really high carbon that is needed, or high carbon when it may be that high silicon would answer the purpose very much better?

For various kinds of work, different grades of iron are required; stove plate and the like demand fluidity and softness, and to secure these an iron high in silicon, high in phosphorus, and rather low in carbon and manganese is most used. For light machinery, an iron high in silicon, medium in carbon and phosphorus and low in sulphur and manganese is necessary. Medium machinery requires an iron medium in silicon and carbon, low in phosphorus and manganese. In heavy machinery where weight rather than strength is desired, and where castings must be free from shrinks and segregations, iron low in silicon and phosphorus, high in carbon and manganese is essential, and a somewhat higher percentage of sulphur may be permitted. In castings where a high strength is desired, an iron low in silicon, low in carbon, low in phosphorus, low in sulphur, and medium in manganese is necessary. Cupolas then, should be so constructed as to best melt an iron suited for grades of its particular foundry.

The height of the tuyers must regulate the manner in which the iron is taken from the cupola. Low tuyers necessitate that the iron be drawn from the cupola as fast as it is melted, and either be held in a reservoir or taken away in small ladles. High tuyers allow the iron to be collected in the hearth of the cupola and to be drawn off in large taps, and have the advantage of allowing crane ladles to be shifted while the iron is collecting in the cupola. When low tuyers are used for filling crane ladles, if any time is apt to be lost in changing the ladles, two spouts should be used, one ladle being placed in position while the other is filling. We have mentioned that for stove plate and like kinds of work, a high silicon, low carbon, low sulphur and low manganese iron is best suited. We have also mentioned that the

amount of carbon and sulphur which an iron will absorb is dependent upon the amount of fuel which it passes through. Hence for stove plate, and like work, the lower the tuyers, provided they are consistent with good melting, the better suited will the iron be for the work. This does not interfere with the general practice in stove plate shops of removing the iron in hand ladles and by trolley tracks as fast as it is melted. Light and medium machinery castings require only a medium carbon percentage, and are much more advantageously melted in low tuyer cupolas. The somewhat lower silicon used in this line of work furnishes a higher carbon than is present in stove plate iron, and the small bed gives a low sulphur percentage. In the heavy machinery where softness and soundness are required, a large bed has an advantage. Low silicon irons which are cheaper may be used, and the carbon absorbed from the deep bed makes an iron high in carbon, while the resulting high percentage of sulphur is less detrimental in this heavy grade of work. The deep hearth allows the collection of a large amount of iron and thus makes the custom of tapping into crane ladles practicable. In the so-called strong irons, named by some gun iron, by others semi-steel, we have a somewhat more complicated problem. These irons must, first of all, be low in carbon and low in sulphur, and it is just such irons as these that absorb most readily carbon and sulphur from the fuel. There are cupolas in operation in many of our foundries from which it is practically impossible to obtain an iron above 28,000 pounds tensile strength for the reason that the height of the tuyers requires so great a depth of fuel in the bed, that the iron will absorb an amount of carbon and sulphur so great that it is impossible to get a strong casting. For the melting of this grade of iron, low tuyers are essential, and, of course, the iron must be removed from the cupola as fast as it is melted. The majority of cupolas in operation to-day have extremely high tuyers, and we have seen that these are advantageous for but a single grade of work. In advocating the lower tuyers for cupolas I have always met with the above mentioned objection in regard to changing the ladles in time to prevent the iron getting into the tuyers. It is to obviate this difficulty that I suggest the double spout on cupolas which are so arranged as to make this possible. The modern tendency in building cupo-

las is to make the tuyers as low as possible in order to show a high fuel ratio, and I venture to predict that they will be built much lower as soon as the double spout arrangement is more universally adopted.

The time has come when all foundrymen must unite in improving cast iron. There has been a tendency for each foundryman to keep to himself the results of his own investigation. This is no more than natural, but it has proved a short sighted policy. The fact that you can make a good quality of castings, is no excuse for allowing another founder, through his ignorance, to deprive the cast iron market of certain classes of work which an intelligent iron founder could supply as efficiently as can the maker of steel. There is a large amount of work now being made in steel which good foundry practice could have saved for cast iron. The engineer who has once been disappointed is not apt to blame the maker so much as the product, and so steel is specified where cast iron, through faulty practice, has failed. In its struggle to hold its own cast iron must look to advanced cupola practice for its mainstay. Every branch of the iron business is advancing with rapid strides. Our foundries must wake up to a relization of these conditions. Engineers are more strict in their requirements of cast iron, while founders are drawing closer specifications around the pig iron furnace men. They in turn are constantly advancing, and I believe in spite of statements to the contrary, that blast furnaces have never produced a better and more uniform product than they are producing to-day. The adoption of standard methods for analyzing and testing, the agitation for improved grading, prove the steady progress in those branches which are vital to future foundry success. Let us then look to our cupola practice, and see to it that in the general progress the very heart of our foundry is not neglected.

For your Buffalo Convention last year, I wrote a paper urging an advancement in foundry metallurgy, suggesting that time which was being spent on worn out topics be devoted to a study of advanced metallurgical conditions. With this thought in view I have studied the various cupola conditions most needing attention, and have presented to you a few of the conclusions at which I have arrived. I have again endeavored to clear away

some of the disagreements which fill foundry literature, and if I have at all succeeded, let me once more ask you to press forward in this investigation, remembering that the very existence of the cast iron foundry depends upon its meeting the advancement of steel with advancement of iron, the cheapening of steel with the cheapening of iron, and the improvement in steel with improvement in iron.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

CAST IRON.

BY PERCY LONGMUIR, MANCHESTER, ENG.

The term "Cast Iron" embraces irons possessing widely different properties. The pig iron of the chemist and the cast iron of the founder are, of course, synonymous terms, cast iron being to all intent and purposes remelted pig. Generally speaking, cast iron may be regarded as metallic iron, associated with varying amounts of carbon, the content of which is seldom lower than 2 per cent. In addition to carbon there are always greater or less amounts of silicon, manganese sulphur and phosphorus present in every variety of cast iron.

Other things being equal the mechanical properties of any variety of cast iron depend upon the amount of these constituents and the relationship they bear to each other. This combination may be such as to favor the production of a high quality iron, or it may be such as to produce one that is poor. High and low quality are terms of convenience rather than of exactitude, and every iron produced is applicable to some definite purpose for which its quality may be regarded as good.

In reviewing the constituent elements of cast iron the foremost and most important in effect is that of carbon. Though it can hardly be said that the presence of any one element definitely rules the quality of cast iron, yet this element closely approaches this position. In a large measure it is the amount of carbon present in any iron that determines its quality and the purpose to which it is adapted. With average grades of cast iron the total carbon present varies between 2 and 4.5 per cent. This latter amount is exceeded in certain alloys such as ferro-manganese or ferro-chrome, but these are instances distinct from the cast irons. The actual occurrence or mode of existence of carbon in iron is to some extent a controversial matter. To the founder, however, who must necessarily keep on the prac-

tical side of science, carbon is known in two conditions, these are as free carbon or graphite, and combined carbon or iron and carbon in a state of definite chemical combination.

Cast iron, whilst fairly strong in compression, is weak in tension. Apart from other contributory causes this low tenacity may, to some extent, be explained by the distribution of the free carbon which is familiarly shown in a fractured sample of pig iron. The flakes of graphite or free carbon when the cast iron is in tension, act as isolating media, and a series of these little cuts, as it were, offer a convenient route along which fracture may readily travel. With a compressive force these conditions are not so evident and consequently cast iron is well adapted to resist crushing forces. Naturally a high content of free carbon denotes a soft iron, but it is the amount of combined carbon that regulates the quality of any iron and determines its suitability to meet any specific purpose. This relationship of carbon and iron is shown to best advantage with the steels, and in all steel works practice a given content of carbon denotes that steel to be applicable to a certain definite purpose. For instance a steel of razor quality would never meet the conditions required from one of "axle" or "tyre," temper and vice versa.

Hence standards have arisen which in the case of ordinary iron carbon steels are of almost universal recognition. These may be briefly summarised as follows:

Class of Steel.	Content of Carbon.	Purpose.
Bessemer	0 20 per cent.	Plates, Sheets etc.
"	0.25 " "	Axle steel.
"	0.30 " "	Tyre steel.
"	0.50 " "	Spring steel.
Open Hearth	0.20 " "	Boiler plates.
" "	0.65 " "	Spring steel.
" "	1.30 " "	Tool steel.
Crucible	0.90 " "	Chisel steel.
"	1 10 " "	Large files, drills, steels.
"	1.20 " "	Turning tool steels.
"	1.40 " "	Saw file steels.
"	1.50 " "	Razor steels.

The utility of carbon standards so well shown in the foregoing table unfortunately cannot be carried to the same exactitude in the case of cast irons. But recognising combined carbon

as the controlling factor the following four percentages give approximate representations of the quality denoted by that percentage:

Content of Combined Carbon.	Variety of Cast Iron.
0.10 per cent.	Dead soft.
0.20 " "	Soft.
0.50 " "	Highest tensile strength.
0.70 " "	Highest transverse "

These figures relate of course to irons of normal qualities. The difficulties in fixing exact carbon standards for cast irons are great, owing to the complex character of the metal and the high content of elements other than iron.

From carbon to sulphur is a fairly natural step owing to a relationship often found between these two elements in a series of ascending irons produced from a similar grade of ore. Sulphurous irons, apart from other drawbacks, are generally speaking "hard." This hardness and the relationship just spoken of may be found in the fact that high sulphurs usually accompany high combined carbons. A glance at the following series of ascending irons will illustrate this feature:

Number of iron	1	2	3	4	5	Mottled	White
Combined Carbon	0.50	0.60	0.80	1.10	1.30	1.80	3.00
Sulphur	0.02	0.02	0.04	0.08	0.11	0.15	0.20
Silicon	2.50	2.30	1.80	1.50	1.20	0.70	0.30

When producing iron in the blast furnace the lower temperatures favor the production of sulphurous irons, high in combined carbon and correspondingly "hard" or "white." These conditions are intensified if the slag be strongly acid, and are restricted if much manganese be present, sulphur in the latter case combining with the manganese, forming a slag of manganous sulphide. These conditions are interesting to founders in that the cupola furnace bears a certain analogy to the blast furnace.

With the cupola slow melting, accompanied by a low temperature, yield conditions which favor the taking up of more sulphur from the coke than is the case with quick working at high temperatures. An interesting increase in sulphur resulting

from three remeltings is shown below, which, by the way, is not given as representing first-class melting practice.

	1st melt	2nd melt	3rd melt
Sulphur %	0.04	0.10	0.20

Phosphorus appears to have little effect on the combined carbon, and in a series of ascending irons this element usually remains fairly constant. To some extent it lightens the appearance of a fracture and has a slight hardening effect on the iron with which it is associated. From a foundry point of view phosphorus is not nearly so harmful as sulphur, and is less of an evil to the iron founder than the steel maker. Phosphorus in cast iron promotes soundness, increases fluidity, and with it the capacity for taking and retaining the sharpest details of a mould. Castings such as machine details, gearing and the like, which have a fair amount of shock to resist, may contain up to 5 per cent. phosphorus. However the general run of castings may contain up to 1.5 per cent., but higher percentages than this are only advisable for castings in which strength is immaterial.

Manganese increases the capacity of an iron for carrying carbon and by permitting the formation of double carbides of iron and manganese increases the hardness according to the content present. This hardening effect is, however, neutralized in the presence of high silicon.

Iron and manganese combine in proportions up to 80 per cent. of the latter, the product being the familiar ferro-manganese. With lower amounts of manganese, that is between 12 and 20 per cent. the product, is known as "spiegel" or "spiegeleisen."

Manganiferous pig irons are specially useful in foundry practice for mixing with others contaminated with an excess of sulphur. In this manner manganese may act as a softener, that is by effecting the removal of sulphur. Generally manganese increases the hardness and closes the grain, and hence is valuable in castings that have to be finished up dead smooth. With an iron in which silicon and sulphur are normal from 1 to 1.50 per cent., manganese will do all that is desired. Of this quantity a certain amount will be oxidised, which, varying with

furnace conditions may reach a total of 40 per cent.

Silicon is present in every variety of cast iron, and owing to its effect on the formation of combined carbon has been conveniently regarded as a ready means of controlling the quality of an iron. Silicon acts indirectly as a "softener" by producing conditions which favor the precipitation of carbon in the graphitic form, and other things being equal results in an iron, the softness of which depends upon the extent of this precipitation. Hence the silicon contents of various irons offer ready means for the adjustment of mixtures, and consequently there have arisen silicon standards. In general practice these standards cover the percentages of silicon from 0.5 to 2.5, ranging from castings such as cylinders and valve bodies down to soft castings, pulleys and the like. The influence of silicon on cast iron has been very fully investigated by Professor Turner, of Birmingham University in England, and by Mr. W. J. Keep, of Detroit. The following table is a summary of Professor Turner's results:

	Content of Silicon per cent.
Cast iron yielding maximum hardness	0.60
" " " " crushing strength	0.80
" " " " density in mass	1.00
" " " " crushing, tensile, transverse strength	1.40
" " " " tensile strength only	1.80
" " " " softness and general working qualities	2.50

The utility of silicon standards is shown in the foregoing table, and for general purposes a mixture figured on the content of silicon alone will give a reliable result. But it must be remembered that silicon acts indirectly, and that it is the combined carbon that rules the destiny of any iron. The relationship of silicon and combined carbon are shown in the analyses quoted earlier in this paper.

Very briefly the elements present in every variety of commercial cast iron, have been mentioned, and in addition to these already quoted the number may be increased by the designed or accidental presence of other metals, such as aluminum, copper, titanium, chromium, etc. Therefore the simplest variety of cast iron is necessarily of a complex character, the physical proper-

ties of which are dependent upon the relationship these constituents bear to each other.

Of these constituents there are never less than seven present, or if we regard cast iron as a single metal, contaminated with foreign elements, we then have a body of iron associated with greater or less quantities of other six dissimilar bodies. That is to say iron is the matrix, and through this are distributed—as fruit through a cake—the other ingredients. Questions naturally arise as to the mode or manner of this distribution. Does the element in question penetrate the iron evenly and as an element?—if so my illustration of the fruit through a cake is inadmissable. Or is the element distributed in patches, as an element, through the iron? That is to say, do particles of iron, particles of manganese and particles of sulphur exist in contiguity, and as free elements? With the one exception of graphite, practical experience would not confirm such a supposition. On the other hand do the elements form definite compounds with portions of the iron in which they are held, and in the cold solidified metal exist as definite chemical compounds? A further point also occurs under this head, and that is as to the manner in which enormous physical changes are produced by the presence of exceedingly small amounts of foreign matter—sulphur forming a familiar example of this effect of traces. These and like questions lead one into a maze of scientific theory and speculation. Therefore the following fragmentary jottings are merely suggestive, and not in any sense conclusive.

In viewing the seven constituents that together form cast iron, it is evident that one, graphite, does exist in a state of freedom—that is as a form of carbon pure and simple. It has a mechanical effect as shown earlier, and it produces softness in the iron indirectly by reducing the amount of carbon available for combination. Graphite, therefore, having only a mechanical effect, can only act within fairly well recognized limits. But it requires no great stretch of imagination to realize in part the latitude in character offered by the remaining six constituents. Carbides of iron and manganese, silicides of iron, sulphides of iron or of manganese and phosphides of iron interspersed through free iron offer a range of latitude, varying ac-

cording to the degree of the penetration of the iron by the compounds. In this manner the effect of mere traces may be followed. Sulphur in suitable combination with iron or manganese in the form of a brittle sulphide, will occupy an area out of all proportion to the minute quantity of free sulphur originally present—the trace thus becoming enormously multiplied, and its effect carried to a far greater extent than any possible by the element in its free state. The energetic effect of small amounts of combined carbon may be accounted for in this manner and with an increasing content of carbon a greater distribution of the carbide occurs and yields a degree of hardness proportionate to the amount of carbide present. It is evident however, that a point must be reached at which saturation occurs, that is to say, when the iron has combined with as much carbon, phosphorus or other element as it can hold—the intrusive compound then penetrating the whole of the metal and corresponding with the disappearance of free iron. That this is the case has been very clearly and forcibly demonstrated by Professor Arnold in his exhaustive researches on carbon on iron.

Further thoughts are also suggested in that each of these carbides, silicides, phosphides and sulphides possess varying coefficients of contraction and must necessarily possess varying points of crystallisation—that is to say, the compounds will crystalise according to their degree of fusibility and therefore crystallisation may extend over a wide range of temperature. Conversely on heating the more fusible compounds will naturally be the first to soften and liquify. Therefore at temperatures far below solidification point there may exist within the frozen metal pasty or semi-pasty particles of a readily fusible compound. Founders who have observed pig iron melting on the hearth of a reverberatory furnace or an ingot of brass in a crucible, will have noticed on exudation of these fusible compounds before the liquifaction of the pig or the ingot.

There must be then within a mass of cast iron containing say 93 per cent. iron and 7 per cent. of other constituents, many conflicting forces, and the question arises at what temperature is an equilibrium established. It is evident that in large castings these internal forces are intensified by the unequal cooling from outside to centre, and that in a mass so cooling each rise of

temperature towards the interior will represent a more or less distinct state of strain, but as the outside crust freezes the internal strains are imprisoned and the question again arises when is an equilibrium established.

These thoughts are of interest chiefly in the case of castings which are employed in positions in which temperature plays a part. It is within every day experience that occasionally a casting successfully treated hydraulically will fail when put on steam trial. May not this failure be due to the presence of compounds which are affected by the temperature of the steam? Imagining for one moment a solid consisting of several dissimilar ingredients distributed with more or less regularity through a common matrix, and we have a fair idea as to the structure of solidified cast iron. On the application of heat an expansion occurs and the more fusible areas distributed through the iron begin to soften and so destroy the continuity of the mass, rendering it liable to rupture by shock. Assuming that the temperature be too low to soften these compounds, but that it be sufficiently high to modify their structural arrangement, we then have a possible explanation as to why in certain cases a casting will resist a definite pressure applied by means of cold water, and yet will leak on a similar trial by steam.

Temperature and pressure seriously affect the working life of any casting, but generally speaking iron castings are not subjected to extremes on either hand.

Further than this it is usually the custom to design castings of greater bulk than that theoretically demanded in order to secure stability. This excess of bulk forms in most cases a reliable factor of safety, allowing the casting ample margin to efficiently meet the usual working conditions. It is of course abnormal results that direct attention to the possible combination of the constituents of cast iron in either beneficial or adverse forms.

The writer had hoped to illustrate this paper by a few micrographs and typical cast iron, but regrets that the available free time precluded this.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

SHOP TOOLS AND RIGS.

BY JAMES A. MURPHY, ERIE, PA.

Among the greatest economizers in our modern shops are properly designed tools and rigs, and not enough attention is usually paid to this end of the business. I do not mean to speak of such special foundry machinery as is usually procured from foundry supply houses, but those indespensable tools of our own "get up" for lifting and conveying our molds and material and the rigs we use for making our molds in sand and loam.

Aside from first class management, the design and equipment of a shop is the greatest factor in cheap production. No shop with pretensions to being modern, should be without one or more travelling cranes, but these should be supported by a system of auxilliary lifts along the sides of the shop. That travelling cranes are in many places a detriment to cheap production instead of an aid is partly because of this omission, and partly because many places do not know how to work them to the best advantage. It is a patent fact to all close observers that in shops having the best equipment, molders are kept continually waiting for lifts. Many reasons and excuses can be given, but the principal one is that our own inventive abilities have not kept pace with the times. Our flasks are designed without any thought of quick handling, and our lifting and hitching tools for the most part remain a relic of 30 years ago.

When a journeyman I worked in some large shops where only one set of lifting chains were provided, and when they broke, which was quite frequently, because of illusage, the greater part of the shop's crew was idle, waiting until they were repaired, which took some time as in one or two instances the

blacksmith's shop was at a considerable distance.

That there should be two or more sets of chains of different sizes as well as plenty of hooks, slings, etc., the best managers

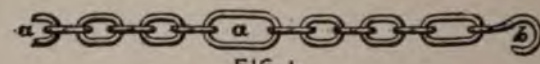
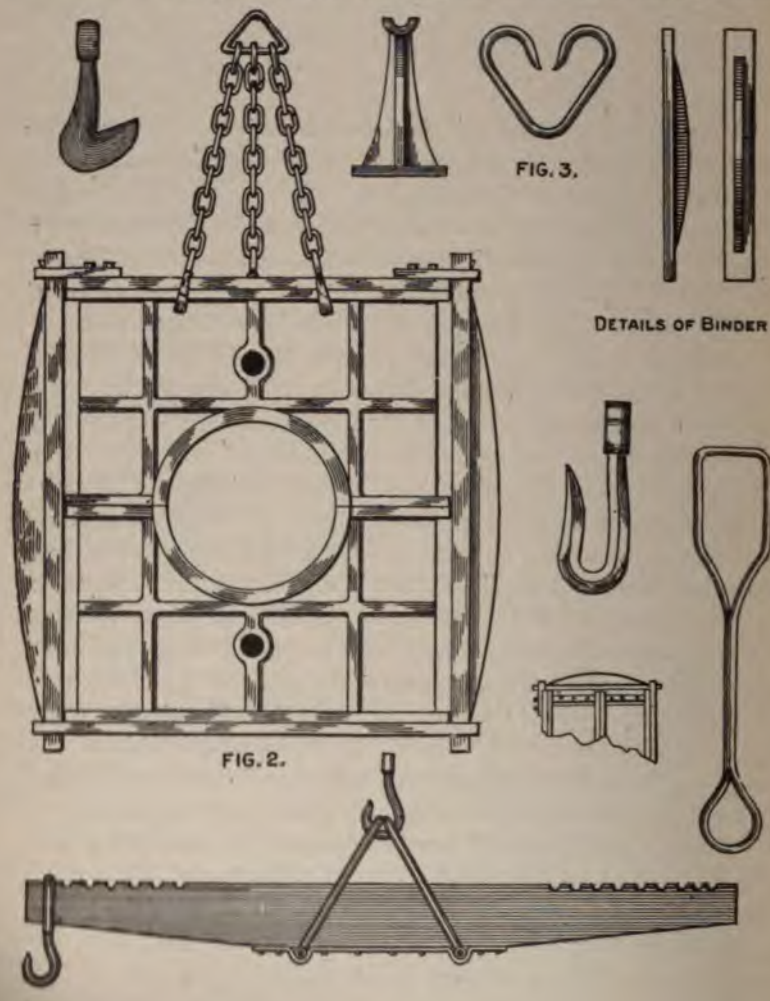


FIG. 1.

will admit. Fig. I is a style of lifting chain which I have in use,



it adapts itself to four different lengths and gives admirable satisfaction. Two large links, (a) being placed at convenient points to allow for the doubling up and insertion of the hook (b). Fig. II is a sketch of the handiest lifting apparatus used in the foundry. Its easy adjustibility and quick action are its best recommendations. The sketch shows it hitched on a large cyclinder flask, (just the opposite from the way it is usually hitched on long flasks). When the flask is lifted off it is set so that the trunnions will rest in the horse at the right of the figure. The cope is then easily turned over by the men and the crane can pass along to further work. This operation when managed properly does not take more than a fraction of a minute.

The figure also shows a method of binding which as far as I am aware is a new departure. It does away with the necessity of placing long bolts in bottom and top of flasks, and then screwing them up with binder in position. The cyclinder flask shown has no bars, although the bore is 28", but instead an iron grid on top to which are attached wrough iron eyes for the binder to go through. They are also cast in the grate on the bottom. All that it is necessary to do is to push the binder up a little and let it fall into its place in the bottom plate. A few wedges here and there and it is secure. By this means a man will securely bind a large mold in a few minutes. By some other methods in vogue this would take hours.

There is another point about the cant-hooks that should not be lost sight of and that is where copes that are only partly rammed up or have cores hanging from them, so as to make a level lift with the chains tedious, they are just the thing, as they will catch equally well anywhere on the flanges. For lifting any castings that have flanges or other projections out of the floor they have no superior. They are perfectly safe and when in use a short time they are considered indispensable.

The shifting or changing hook is a valuable tool, and mostly all shops have some kind of an arrangement. As it is usual, when carrying cores, ladles, and miscellaneous loads on the traveller, to first set them down before transferring to another crane, much time is saved by using a proper changing hook. With a hook such as is shown in the sketch Fig. 3, it would be a quick and easy operation to lower off a load from the traveller to one

of the side jib cranes. The hook has the advantage of a small first cost. No welds, easily managed, and thoroughly safe and serviceable.

The method of making flasks and the style of construction is a matter of great importance to most shops. I generally have a frame or outline of the part I want made by the carpenter, and the rest swept in the floor and cast open sand.

I append a sketch of a rather crooked "rig" for making the housing of a large vertical engine which was made in this way. Its general dimensions are about 13 ft. long, 4 ft. wide and 4 ft. deep. Aside from the cost of the metal, bolts and pins it cost me for pattern making $2.50, molding $14.07 and common labor $3.00, or a total cost of $19.57, which certainly is cheap for a flask of its size. The bottom plate was made in two parts so as to come in handy afterwards for core plates as shown in Fig. 4. The sketch itself is shown in Fig. 7 .

Speaking of core plates, how many of us are there who have

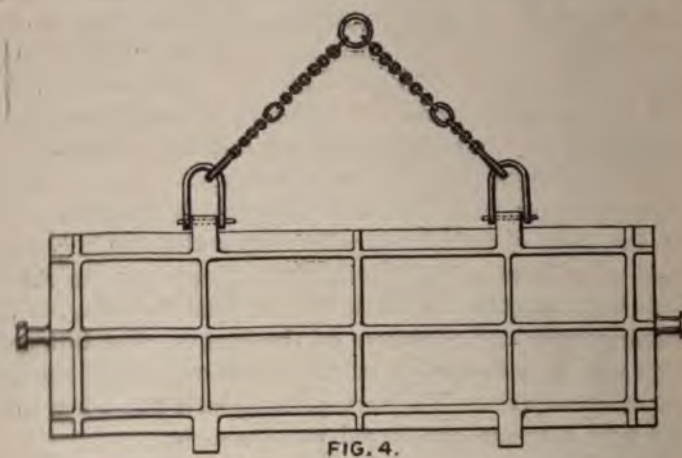


FIG. 4.

not seen the slip shod manner in which they are constructed in all shops, and how core-makers have to put chains around core box and plate to enable them to "roll over." Such a method is not allowable in the best practice except in extreme cases. A plate the back view of which is shown, accomplishes the purpose of saving the core box, and the rolling over is easier, far quicker,

and safer. The box will not slip from the plate if securely clamped as it should be in any case. In some cases I cast in steel trunnions on the ends and find they often come in very handy. In others I core out hole and thread it, so that a trunnion with a standard thread can be screwed in in case of necessity. Many cores are got out of shape by rolling over in the old way, besides marring the boxes. Plates should be well ribbed and strong enough to prevent springing. The plate shown is a time saver and has many advantages over those in almost universal use.

The most clumsy tool among foundry lifting devices is the more or less modern I beam, and the cast iron and oak beams will remain with us for many years to come. For very large work I prefer a well designed cast iron or cast steel beam, while for medium work I have a decided liking for the oak on account of its lightness and general handiness. An oak beam like the sketch I made some time ago, and it is a perfectly satisfactory tool in every respect. It will be seen that the beam is not weakened at any point by holes for the clevices, they being bolted to a wrought iron strap running under the beam and forming a perfect rest for it. It is secured to the beam with lag screws. A beam, hook and sling are shown in the illustration.

There are really few flask pins that give satisfaction. The device shown in Fig. 6 I have in use nearly two years on a set of

FIG. 6.

bench flasks, and so far is perfectly serviceable in every respect.

It combines the handle pin and clamp, or fastening device, by simply pushing in a cut spike when the flask is closed, there being a shoulder on the pin for this purpose. The device is cast iron. I also employ the same style with slight alterations on all my wooden boxes with very gratifying results. The flask has not to be cut to put them on as they are simply screwed to the side. They are very quickly put on and the molder never has to take his lifter to pick the dirt out of the holes.

There could be many other things said on this inexhaustible subject which the limits of a brief paper of this kind necessarily curtails. "Repeat moulding" in loam and sand, and special rigs for rapid molding. I may in the near future make the subjects of another paper as these matters are very interesting to foundry managers, as it is in these particulars that the ingenuity and real ability of the foundryman is shown. The best pusher is he who gets up good "rigs," not for one particular job, but for everything. Never think you have completed making improvements, there is always room. On many classes of work the foreman must be an engineer of no mean ability, and if he does not know his business, it will tell in construction work quicker than any other branch of the foundry management, excepting, possibly, the mixing and melting of iron.

It is a common thing, in many shops, when a large cope is to be kept above the floor, to pile up the whole place with small wooden boxes, barrels and other truck to support it. A very light and handy set of horses for such purposes should be a part of every shop's equipment. I cannot imagine anything cheaper than the design shown in the sketch, as only some old pipe is needed and have a cast iron flange run around them on both ends. A sketch is shown (Fig. 5). The clutch hook is also handy on the end of a strong chain for lifting awkward castings. The greatest care should be taken of chains and hooks, and they should be kept safe by occassional annealing. The loss of life which in many cases is akin to murder is due in a great measure to this carelessness. Well designed lift-

ing apparatus is a money maker, and the greatest of diligence should be exerted in keeping it in good and proper order.

FIG. 5.

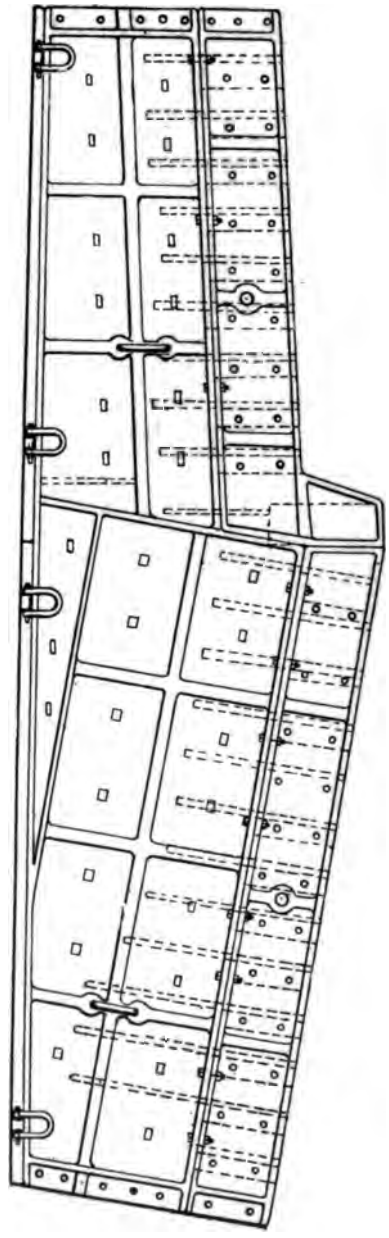


FIG. 7

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

FOUNDRY ACCOUNTING.

BY J. G. STEWART, NORTH ORMSBY, ENGLAND.

In compiling this paper I have started with the assumption that all those who read it are ignorant of the inner workings of a foundry or general engineering shop; that their knowledge of what goes to make up a cost account is nil. Therefore, I hope a little liberty in the introductory portion of the paper will be granted me.

Cost accounts and the important part they play in the success or failure of a business, do not always receive the consideration they are entitled to, but are looked upon as a conglomeration of figures and often not worth the paper on which they are detailed. In fact the idea prevails with some men, to quote from actual experience, "that concern which will not stand mismanagement is not worth tackling."

To every business man in the foundry line it will be apparent that he should become familiar with the commercial as well as the practical branch of his business, and as a great deal of his success depends upon close attention to detail, he very soon realizes the importance of the cost department. Here is the key to a financial success, and to a large extent the prosperity or failure of a firm is traceable to the importance they attach to the question of cost accounts.

There are many, I am sorry to say, who do not pay any attention to the cost of production, but go on in a slip shod way, until they find themselves gradually ousted from the place they once held, owing to their lack of business ability. There are a few who have striven hard to keep afloat by close attention to business, but have failed through lack of capital. These cases are few, however, in comparison with those that have had the means at their disposal and have yet failed.

Business has almost become a fine art, and among the foun-

dries especially, this is so. The time has now come when foundrymen should bestir themselves and tackle the cost question in real earnest. There are many even in this advanced age, who never ask themselves—"am I paying too much for this, that, or the other," nor do they try to ascertain which class of work pays and which does not; so long as a profit is shown, that is all that they require.

The economical and successful working of a foundry plant is the result of close watching. The purchasing of materials in the right market and at the proper time, watching the market reports, exercising judgment and buying accordingly; the practical, theoretical, and technical education and business ability of the management, the accuracy of the estimating and costing department, the co-operation of the officials, foremen and workmen, all tend to the success of an undertaking.

The cost department is essential for the successful working of a manufacturing business. It is possible in a properly managed shop for the cost of every article to be detailed and tabulated from the small castings of a few ounces to the monster pieces weighing 30 or more tons.

With the right man at the head of the cost department, who is thoroughly acquainted with the requirements of a foundry, working amicably with the heads of the moulding shop, information can be readily obtained and accurately tabulated.

If the principal of cost-keeping was better understood we should have fewer cases of failure to report. Huge successes probably would not be heard of so often, as a keener competition would result and it would then be a question of quality and workmanship plus influence, rather than price that would secure the largest share of work.

It will be difficult to lay down hard and fast rules to be followed by firms, big and little, but the system suitable to a large concern can be so modified as to be applicable to a smaller one.

To enable us to compete favorably in the open market we must see that our shop is well placed, well equipped with modern labor-saving appliances; comfortably warm and light in winter, and well ventilated in summer, facility for handling traffic by rail, road or water; the means for storage of boxes, loam plates, etc., with due consideration to available land for extension. Good

management, and an expert and efficient office-staff, and the reward of success is certain.

Having arranged the location and equipment of the foundry we turn our attention to the question of a foundry manager in whom should be vested power to enquire into all matters appertaining to his particular department. The qualifications for such a post should be, a good technical knowledge, added to a practical experience, not only of moulding and core-making in the various classes, but cupola practice and metal mixing; these combined with a sound knowledge of the commercial branch of the business, and a firm, yet kind manner.

The proprietors of the small shop, I am aware, has to be his own manager and foreman, too, but even he can take the principle of the foregoing paragraph and learn his lesson well therefrom. The foreman, while possessing a good practical knowledge and experience in the art of moulding should be able to portion out his work to advantage, and have an idea of the value of the core-making and moulding of each piece. He should be kept free from account books of any kind, leaving him at liberty to superintend the men and direct the work of the shop. To the foreman we look for the output of castings, and only when some serious increase of expenditure is incurred need we trouble him about the cost accounting.

The clerks or commercial men should be made specialists in their particular line, for there are many things in a foundry with which they must become familiar before any reliance can be placed upon their work. With some firms, too much notice is taken of the officials in the general office respecting the working of the foundry. If these could be persuaded to go into a casting shop when a big job is being poured, they would vote it a filthy place, and not fit for them to be in. On such individuals is sometimes, however, bestowed the important work of making up costs and estimates, and to such, a foreman is expected to bow and scrape his allegiance and pour out his own knowledge and wisdom for the benefit and probable promotion of his hearer, and the possible downfall of himself. Kirk in his book on "Cupola Practice" mentions the fact "that metal is melted in the office with less coke than it is in a cupola."

Therefore the office-man for the foundry department should

be selected from those who know their own business and the requirements of a foundry. A man who devotes himself to studying his work, who takes a delight in all things appertaining to the foundry, who spares neither time or money to thoroughly master every detail in founding, such a man is a credit to the firm and a source of strength in the upbuilding of a business, for reliance can be placed on his work and methods.

Let us start with the Commercial branch of the business first, follow it step by step and witness the relative workings of the commercial and practical parts, and we shall see how, in a properly organized establishment and under capable management, the whole concern works smoothly, wheels within wheels, and at the year end a balance sheet envied by many, equalled by some, but surpassed by none, is the outcome, always allowing that you have men engaged who not only know their business, but practice what they know. The commercial staff must be awake to the duties required of it.

Suppose an order has come, and the drawing are in the hands of the draughtsmen. It may be that dozens of castings are required to enable the work to be completed. We require some system whereby we can keep track of the job as it goes through the various shops.

Therefore the draughtsman's first aim should be to obtain a distinguishing number or mark, to ensure his being able to readily turn to the drawings or tracings in question.

Now, in a methodical office, the original order, after certain particulars have been noted, would be handed to the person in charge of the cost department, who would make an entry in his Order or Contract Number book. Here we shall find the number assigned to the work under consideration is, say No. 1. The date of the order, the firm's name and probably address for whom the work is required, with any other necessary particulars are entered. The original order is also duly numbered (No. 1) to correspond with that in the order book. The order is then passed on to the clerk in charge of the "outwards" traffic and "outwards" invoices. He in turn makes the notes requisite to his department, where, when, and how delivery is to be made, amount of contract, and any special shipping or erection marks. The order now goes back to the management where it is retained.

Any alterations or additions to the order should be notified to those whom it concerns by a typewritten slip, in fact, all instructions should be typewritten. In some concerns it is customary to send typewritten slips to the head foreman in each department notifying them of the receipt of an order, giving the office contract No., and any special instructions necessary. By this means the whole of the officials are kept informed of what is going on, and are anxious that their's is not the department to keep an order waiting. All are on the look out, and as soon as the castings or whatever class of work it may be, make their appearance, the work is at once proceeded with.

To return to the draughtsman. He has obtained the distinctive number (No. 1) and he proceeds with the various tracings, taking care that before they leave his department they are duly marked. The pattern-maker commences his work, and as soon as he has any patterns ready for the foundry they are stamped 1, a gummed label is stuck on, one which will be detailed the Contract No., name of the particular castings and number required. The pattern-makers enter the number of hours spent preparing patterns for the different parts, and specifying the particular part, on their timeboards each day.

The material used on the job is entered on a sheet, a supply of which is given to each man. (All timber, etc., is charged to the pattern-shop account, through what is termed "the impersonal accounts" which is described later). When he requires timber for say Bedplate Order No. 1, he makes the necessary entry as under:

Wood Sheet, week ending.....

Board No. 333 Name.....

Contract or Order No.	Particulars.	Description.	Length ft.	Length in.	Width in.	Thick. in.
1	Bedplate	Yellow Pine	10	0	6	1
1	L. P. Cylinder Cover (Loam Board)	do	7	6	5	¾

The foreman pattern-maker in checking over the time-board and wood sheets, if he is up to his profession, can readily detect any discrepancy in the entering. As the castings are made, or as the moulding and core-making progresses the workmen enter their time to the castings, etc., on which they have worked, stating the order number in all cases.

The foundry weighman, whose duty it should be to obtain a detailed list of castings made the previous day, has all the required information given to him by the workmen, he weights, and marks (in white paint) the order number on each casting, and away they go to the machine shop to be dealt with according to the laws of the establishment, every man bearing in mind that he has to furnish a record of the time spent on the various parts which go to make up the Engine, Machine or whatever the work may be.

Daily list of Castings Made — Monday, May 5th, 1902. Week Ending May 10th. 1902.

Order or Contract Number	Number of castings	Description of castings	Pattern shop order No.	Weight T.	Cwt.	
1	1	Bedplate	22	7	10	– –
1	1	L P. Cylinder	7	5	3	2 14
3	20	Fire bars	5	–	6	0 14

Now it may be asked how do you keep a record of all this? Simple enough. The draughtsman keeps a record of all the tracings that have gone into the pattern or machine shop. The foreman pattern-maker as soon as he has the patterns ready issues an order (the counterfoil of which he keeps) on the foundry for so many castings.

Take the main bearing bushes for example. The foreman moulder gathers from this that he has 6 castings to make off one pattern, and 5 off the other, then the pattern is to be altered for the 6th. The clerk whose duty it is, keeps a record of the castings made, cleaned and weighed off, and makes a note to that

Pattern Shop Order.

Remarks :—

Pattern returned

(Name of Town) .....Date.....190 No. P 22

To Messrs.....

.....

Please supply

1	Bedplate	Contract	1
6	Main bearing Bottom Bushes	"	1
6	.do Top " (5 off then alter)	Contract	1
250	Firebars - - - - -	"	7

For (name of firm) Signature or initials.....

effect on the original pattern-shop order, or in any special book kept for the purpose (when the patternshop order is marked it saves unnecessary labor and expense).

When the requisite No. of castings have been made off a pattern, and, as far as can be ascertained, are pronounced sound, the pattern is sent back to the pattern-shop and a note made in the order book of the date on which it is returned. Should more castings be accounted for than are required then enquiries should be made and a satisfactory explanation asked for.

One of the leading rules of the establishment should be "promises must be fulfilled," and if all officials have this rule impressed on their memory, everything will go smoothly, but so soon as the management relaxes its hold or gives way on small details, the business will soon begin to fall away. A firm with a reputation for keeping to promises will ultimately succeed.

The next question is that of the timekeeping system. To enable us to arrive at the cost of labor on any particular castings we must have some means whereby a record is kept of each man's time, and the particular piece on which he has been employed. The timekeeper is, therefore, supplied with certain information sufficient for his purpose, including the firm's contract numbers. As each man's time-board is returned to the office, giving particulars of the jobs and order number, with the number of hours spent on each. The day's time is chcked over and next morning the boards are submitted to the foreman to certify them as correct, after which the particulars are entered on specially ruled loose sheets, and as each order number comes before the notice of the timekeeper, he having already the information at hand is able to detect any error on the part of the workman respecting numbers, the nature and name of job having already been certified.

I am bound to admit that in a number of concerns the signing of boards is a mere matter of form, but in a properly organized establishment it is anything but a formality. Insist on the correct details being sent in, return the time-board for correction, and if repeated mistakes occur inform the foreman of such gross carelessness and the men will soon see that they and the office must work together in this respect or there's going to be trouble. The loose sheets referred to are ruled as under:

WAGES. Week ending.....

Board No.	Workman's Name.	Rate of Wages.	Particulars. Job	Order no	Su	M	T	W	Th	F	S	Total hours.	Abstract account.		Amount of Wages		Hospt'l &c ded'ct's
Loam	Molders																
1	John Smith	38	Cylinder cores	1	–	9¾	9½			4		23	16	6			
			Bedplate cores	1				9½	3			12½	9				
			L. P. Cyl. cover	1					6½	5½		12	8	7			
			M. P. piston	1							5½	5½	3				
												53			18	0	£2

(We work 53 hours a week here, and I have given the illustration as such.)

The time, day by day, is recorded, with the name and order number of job. At the week end the total time spent on each item is made, the grand total of hours for the week filled in and the timekeeper's duties with the sheets for that particular week ceases. In some works it is customary for the timekeeper to complete the wages and make the abstract for cost purposes, but where a sufficient staff is kept the £ s. d. should be worked out and the wages paid to the men by a separate department. The loose sheets enable several hands being set on, preparing them for the final of the pay as well as the use of the cost clerk.

The total time is first checked over, then the gross amount of wages due filled in the proper column. The sheets are then passed on to someone else who fills in the abstract or detail portion, which total amount should agree with that of the gross amount. By this means the workings are proved, and enables the additions to be made with greater speed, one column checking the other.

As soon as a number of sheets are ready and in numerical order, they are passed on to the cost clerk or his assistants who proceed to abstract the details, debiting each order number and each piece of work with the amount of wages expended on it.

If there should be a pattern shop or machine and fitting shop in conjunction with the concern, the amount spent in each branch should be stated.

While the costing department is busy abstracting the wages account, let us go for a while to the foundry and see what hints and ideas we can pick up. While allowing that the foreman moulder must to a large extent be responsible for the amount of labor employed in his shop, there are many little details needing attention to which he cannot reasonably be expected to pay heed, so a superintendent over the laborers is appointed and to him we must look to successfully manage the unskilled labor. He should be a man of energy and perseverance, know how to distribute his men to advantage, always be planning ahead, and as far as possible have his men and work so arranged that a good start is made first thing in the morning. Let him feel that he is responsible for the successful handling of the men, and he will soon appreciate the confidence reposed in him, and will be wishful to

work harmoniously with the office and render all the assistance possible to enable an accurate return being made of the unskilled labor cost.

In a shop employed on big heavy work, the moulders will, doubtless, utilize the time of one or more laborers, in which case the time should be charged to such particular pieces. Laborers' time on the loam floor should be treated similarly or charged as loam-floor labor, so that the loam work is debited with its proportion of labor for each week, but general shop labor should be distributed proportionately over the general green and dry sand work.

Where overhead travellers are employed the cranemen when occupied for any length of time on one particular job, should charge the time so spent to that job, the remainder of the time to be divided over the jobs in the shop which require the use of the crane.

Let us now consider one of the vital parts of founding, viz, the cupola and the charges relative thereto. The cupola and its peculiarities is only beginning to receive due consideration, and we are fast approaching the time when foundrymen will be willing to admit that it is only by judicious treatment and carefully weighing of the burden that we obtain the best and most economic results. Unless we resort to the weighing of the charges, how are we to determine the cost of any one or number of castings. In compiling details for cupola costs we must take into account:

Cupola men (wages).

Laborers unloading pig iron, scrap, etc. (wages).

Fettling required for repairs to cupola; daubing of ladles, etc.

Repairs for renewals of cupola tools (wages and material).

Coke to form bed in cupola.

Quantity and grade of iron charged, also coke and limestone requisite for each charge.

The wages can be obtained week by week from the wage sheets, the fettling used for cupola and ladles from the man

		£	s.	d.	Total		
Wages	Cupola men's wages	–	–	–			
	Blacksmith's " repairing tools	–	–	–	–	–	–
fettling	Material used for repairing tools	–	–	–			
	Fettling for cupola, etc.	–	–	–	–	–	–
fuel & flux	Wood	–	–	–			
	Coke in bed	–	–	–			
	do charges	–	–	–			
	Limestone	–	–	–	–	–	–

Tonnage etc. of Pig Iron and Scrap charged

T	cwt		Grade	Brand	Purchase price	£	s.	d.
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	Total value of Iron			–	–	–
–	–	–	less % melting loss.					
–	–	–	Credit for gates, risers, metal poured on floor, waster castings		@ Scrap price.	–	–	–
–	–	–						
			Total of good castings as per weighmans detail lists or sheets.		Value of iron in same	–	–	–
			Total cost of producing T....Cwt....good castings					

Total		
–	–	–

whose duty it is to keep them in order, the coke, iron, etc., from the man charging the furnace, who should be provided with printed charges sheets, a ruled slate or board on which to state the contents of each charge as it is put on. If the records thus obtained are properly tabulated we shall be able to trace the mixture of irons used for the various castings. At the end of the week the particulars are tabulated and the cost of melting ascertained:

The question of coke consumption for stove fires is a sore point with some iron founders, but a real business manager will seek to know where the leakage is, and have it remedied.

Foundry supplies generally, are a source of annoyance, especially in a works where the foreman does not exercise a little judgment, and enquiry before giving orders to his men. Here again the manager soon puts matters right, and we are able to charge each job with the proper number of chaplets, etc., or the different classes of work with the proportion of supplies used, or the work generally with the tools procured for general use, giving credit to the supplies department.

To facilitate the putting together of figures for a weekly or monthly return, the fettlers should, as far as possible, clean off each day's work as it is brought out of the foundries. If this were insisted on there would not be the number of lost castings nor the extra labor entailed in hunting them up or possibly having them remoulded.

To arrive at the cost of any piece of work we have to account for the amount expended as per wages detail, as well as iron, etc., used, making necessary allowances for melting loss, coke for core and mould drying, fire clay ganister and fire bricks for repairs for cupola, and numerous items with which foundrymen are acquainted, all must be taken into account, and when properly managed the cost accounts will show exactly what has been expended to produce certain work. I have known cases where in making up an estimate, one ton of raw iron was supposed to produce one ton of molten metal in the ladle. The coke for the bed of the cupola and charging was guess work and so was everything else. Needless to say the firms referred to were only in business a short while, from 12 to 18 months.

There are many small foundries that have not work for,

and therefore cannot afford to keep a competent cost clerk fully employed, still the principles laid down, if followed out, should be a saving of cost to the foundryman. I admit it requires close attention to keep things jogging along smoothly, but attention to necessary small detail always recompences for the labor bestowed on them. The things requiring close attention are almost innumerable, and it requires a staff of officials that know the business thoroughly and are able to use the facts and figures which are ascertained in the ordinary routine.

In all enterprises there are certain fixed or establishment charges which have to be accounted for, and due allowances made for them in estimating, and for their proper distribution over the cost of saleable articles turned out. Among the many items which have thus to be accounted for are: Formation expenses; rent, rates and taxes; salaries to officials, etc.; insurance (fire and accident); gas and water; printing and stationery; postal charges; advertising; maintenance and repairs; depreciation in value of fixed plant and machinery; loose plant and tools. The depreciation is dealt with by the accountants at stated periods, say every 6 or 12 months, the other items being detailed in what is termed the "Impersonal Ledger." In this we debit the items mentioned under the heading of Establishment charges (with the exception of depreciation) also the total amount in wages paid to workmen, the different brands of pig iron, cast iron, scrap, coal and coke, sand, limestone or other fluxing materials, coal dust, blacking, plumbago, chaplets, in fact everything chargeable direct to and for the sole use of the foundry. In every case the weight or number, with purchase price, might, with advantage, be stated.

The details are procured from the invoices "inwards," on which the prices as per contract, the money calculations and the weights are first certified as correct. (The weights are obtained from the weighman's goods-received book). The weight and amount to be debited to each account is also specified.

FLASKS AND LOAM PLATES.

This portion of the subject is a difficult matter to settle satisfactorily to all parties. My own idea is to open an account in the cost ledger, debiting the said account with the cost of

making, charging all labor in connection with the making, plus iron, coke, etc., giving credit for them at cast iron scrap price, carrying the difference to profit and loss account. If in the case of a new shop where the bulk of the flasks, etc., are made at the commencement, the difference could be divided over a period of say 3 years. By this method the value of the stock will be kept nearer its real value as an asset, and should the firm through any unforseen circumstance be compelled to give up business and the plant sold, the amount realized and the value as per books will be very nearly equal.

Some firms I know, enter their stock of iron flasks and plates at almost the same price as saleable castings, which is a misrepresentation of the value of the plant to say the least. Flasks and plates are not like machinery, which could probably be disposed of at very little below cost price, (I am speaking now of up-to-date machinery), but who would like to pay say from £4,10 to £6,10 per ton for iron flasks, etc., that are perhaps only worth 50 per cent.; we must also take into consideration the length of time some boxes remain idle. They are depreciating week by week until the rust begins to peel off, the metal becomes weaker and weaker, and yet some people at the year end take credit for them at a fabulous price. Is it honest I would ask you? when a special job comes in (one or two castings off) and special tackle has to be made. I should charge the cost of making the tackle to the job on which it is intended to be used, giving credit, as I say, for the iron as scrap. Then, say 12 months after the specials have been delivered to the customers, no enquiries for the same or similar goods are to had, break up the tackle and utilize the space for something else; you are thus turning to account so much capital otherwise laid idle.

Catalogues.—As can be expected, when a new works is being started, there are always plenty of firms on the look out for new business, consequently catalogues detailing sundry and various requisites, and labor saving appliances begin to pour in. These are a source of annoyance to some people and do not receive any attention. But to a firm desiring to succeed there is nothing so small, but some consideration might with advantage be paid to it. In my mind all catalogues and lists should be numbered, the supplies mentioned indexed, with the name and

address of the firm and the number of the catalogue for reference. If this were done we should have at hand a ready index of everything in the way of foundry requisites. If a second copy of the catalogues could be procured and left in the foundry-foreman's office for his perusal, a few valuable hints might be obtained, besides who is better able to judge of the qualities and usefulness of an article than those who are in daily contact with and who use them.

New Hands.—When moulders and core-makers are being started, it would be a good thing if the foremen were to enquire whether the men have their outfit with them, (that is to say a trowel, cleaner, a 2 foot rule and a hand hammer; and in the case of a loam moulder a rat tail blackwash brush). This precaution would prevent a great deal of time being wasted by men perhaps going all around a shop to borrow something or other with which they ought to have provided themselves before seeking to start work in a new shop, and would no doubt be the means of the men taking more pride and interest in their work. This is perhaps a trifle at sight, but it adds considerable to the cost account to have to pay a man a few half hours looking for the ordinary tools of his trade. In addition he disturbs and annoys his fellows by his queries.

Finally our cost account is presented, the details being obtained as follows:

Skilled labor, etc. (wages) from abstract of wage sheets.

Material used in cupola and cost of melting—from cupola charges sheet, and labor return made weekly.

Supplies—as per priced list of supplies used, made up every week.

Timber for flask bars, gate sticks, scaffolding for loam work, etc.—as per pattern shop charges to foundry account.

Bar iron when obtained from blacksmith's shop—as per smith's shop charges to foundry account through bar iron sheets.

Plus percentage for establishment charges ascertained at stated periods.

The success of certain firms is astonishing, but if asked for the reason the secret will be found in knowing the cost of production, the attention paid to detail and the harmony in which everything and everyone work.

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART 1

REDUCE THE APPRENTICESHIP PERIOD.

BY E. H. PUTNAM, MOLINE, ILLS.

In England, the apprenticeship term used to be seven years. What it is there to-day I do not know; but in America, four years constitute the generally prevailing term.

The conditions existing at the time that seven years was established as the standard justified, no doubt, that long period of service. Nor can it be doubted that progress in the industrial arts, together with advance in the general intelligence warranted the great reduction of the apprenticeship term when four years was adopted as sufficient.

It seems to me that the time is at hand for a still further curtailment. We have made greater advance since the establishment of the four year term than during all the previous history of the world. Any argument that was valid for the drop from seven years to four, applies now with manifold force for another large reduction.

Never before has the demand for skilled labor so greatly outrun that for common, or unskilled labor.

Sustained industrial prosperity depends as much upon supplying the demand for goods as upon the demand itself. If the industrial world take opportunity by the forelock, and so fulfill the prevalent conditions that make for permanence of the marvelous system that is rapidly enriching the people of America, there will be no chance for reactionary elements to gain an effective momentum.

The demand for product exists; all effort should be bent in the direction of supplying the demand.

The factors of the industrial system are inevitably reciprocal. Effective demand cannot exist without its correlative supply, and vice versa.

Now, the upward march of industry has, in large measure, lifted the world's work from the sphere of common labor to that of skilled mechanics. And the transition in this direction is now

more rapid than ever before; and, but for the impediments that ignorance throws in the way of progress, there would soon be an end of all unskilled labor.

Why should any man harvest his wheat with a hand sickle, or plow his ground with a crooked stick? Why should any of the operations of the manufactory be abandoned to so low a plane as to dispense with the element of skill? Nay, rather, why should not every operation of the great industrial machine be so advanced as to require emulation and quick intelligence on the part of every human participant?

Cut the apprenticeship period in two, at the middle. Two years' application will do more toward perfecting a mechanic along modern lines than four years under the ancient regime, when mechanics were of the "all-round" character, instead of being limited specialists, as at present, and as the future will more and more insist upon.

The employe loses far more by loss of business incident to the protracted apprenticeship term than he can possibly gain from the comparatively large profit on the last two years of the apprentice's service. And the whole of society loses the possible increased wealth that would result from duplicating the army of skilled artisans every two years instead of every four. Throw into the balance the intellectual and moral gain of society that would spring from so great an uplift of the submerged, lower stratum of men, and, it seems to me, we have an accumulation of incentives to the proposition that heads this paper that should brush aside every thought of opposition.

THE NEW YORK PUBLIC LIBRARY

Journal of the American Foundrymen's Association.

VOL. XI. JUNE, 1902. PART I.

TECHNICAL EDUCATION.

BY PROF. R. H. RICHARDS.

Another word on the preparation of young men for the foundry business.*

Demands for men in this work seem to be along two lines 1. Apprentices who hope to become expert molders and melters, and 2. Men who enter the business with the intent to become expert foundrymen.

It is of this second class that I wish to say a few words.

The modern metal works are finding it more and more necessary on account of the greater demands of the consumer, to get the right degree of hardness to suit the tool worker, of strength to satisfy the engineer, and of resistance to chemicals to prolong the life of the finished piece. They can no longer afford to ignore the chemistry of the process where a slight increase or decrease of an element may make or mar the result, nor can they afford to ignore metallography which by etched surfaces studies the arrangement of the crystals of the several compounds which go to make up the mass of the casting, and which by their size and arrangement indicate the favorable or unfavorable condition of the metal; nor yet can they ignore the pyrometric measurements by which they can follow the heats through the time of treatment and note the conditions which give more favorable or less favorable results.

The grammar school boy who has passed through the apprentice period has not had the training necessary for intelligently discussing questions of composition, structure, or chemical stability of the metals; the technically educated, while he may not have dealt with the exact questions that come up in foundry practice, has dealt with questions quite as complex, and his school training has largely been in the direction of developing in him breadth of view and quickness of perception, mental

* Notes from the Department of Mining, Engineering and Metallurgy, Massachusetts Institute of Technology.

alertness and adaptability is important in keeping abreast of the modern march of improvement.

It is to say a good word for these men and to ask for them a trial that this paper is written, and it is the belief of the writer that not the young man only will be the gainer, but that the works which gets the right man with technical training will find great advantage therefrom.

Business men will always need to have patience with the school-trained man while he gets his special practical experience, just as they do with the apprentice who makes his blunders which have to be submitted to while he is learning The school man's blunders will teach him something, while the apprentice may get no wisdom. In this time of many books, the school-man has an immense advantage in familiarity with the literature of the subject thus saving time in finding out what others have done, thus saving time in not repeating the disastrous experiments of others. He is also able to find suggestions for new work in his literature which may be as sounding words to the uneducated man.

In the iron and steel business, the school educated man has come to the front. Why should he not also in the foundry business?

NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. OCTOBER, 1902. PART I.

THE STUDY OF THE CUPOLA.

BY ARCH. M. LOUDON, NEW YORK.

At the present time, when so much is said and written about foundry matters, a little more attention should be directed to the practical applications of the Cupola, for the majority of foundries must depend upon uneducated cupola tenders for their success in this line of work.

While it is of the greatest benefit to know all about the scientific methods of making mixtures, yet there are many practical points about a cupola which do not come under the control of the chemist, but which none the less demand an equally careful consideration.

Beginning with the regular morning chipping and daubing up the lining of the cupola, preparatory to charging it, it may be stated that the men entrusted with these operations usually know very little of the why and wherefore of the work, for I have often seen the diameter of the lining across the top of the tuyeres two to

three inches larger than across the bottom, thus causing the iron when melted and dripping down to run into the tuyeres and eventually choke them up.

Had the cupola tender been taught to bridge the top of the tuyeres, and always keep them that way, the bad results coming from this trouble would many times be done away entirely.

In chipping and daubing up the other parts of the cupola which may require attention, I have often seen men use picks or other similar weapons, the result being the coming away of large portions of the lining. In finally repairing these places it may be found necessary to reline half way up, at a cost of possibly 50 dollars. Had the man been properly instructed, much of this expense would have been avoided.

I know from practical experience that equal proportions of Kaolin and Molding Sand, mixed with clay-wash, forms an excellent daubing material, and makes the chipping of the cupola simple and safe, thereby insuring a longer life to the lining. After chipping, apply this material in the form of a thick paste all around from the bottom as far as a man can reach above the melting zone. After putting the bottom plates up and securing them with the bar, take a mixture of old sand, as coarse as possible, and properly tempered to avoid steam and blisters, ram in about nine or ten inches deep, keeping it highest around the walls of the cupola, inclining slightly downward to the tapping hole, and wash over with coke facing or any cheap mineral mixed like black wash.

In following the above method of making the bed, many run-outs may be avoided by those who have this trouble.

Now take a 1¼" pin for the tapping hole, ram up around it with Kaolin only, keeping the pin on the same angle with the bed. Place some oily waste on the bottom, carefully insert the wood so that none of the logs will destroy the bottom, and after this has been all put in the point is reached where the fuel is added, and the chemist can take charge.

THE NEW YORK PUBLIC LIBRARY
99
ASTOR, LENOX AND TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. DECEMBER, 1902. PART I.

THE MELTING RATIO.

BY MR. ARCH M. LOUDON, NEW YORK.

From the reports in the technical press I note that in the November meeting of the Foundrymen's Association of Philadelphia, the melting ratio was thoroughly discussed. This is a step in the right direction, for I believe the financial success of a foundry, at the present time, more so than ever in the history of the industry, necessitates the closest attention on the part of the management to the individual economies.

I was pleased to read the experience of Mr. G. D. Moore, who made a careful 60 days test of 25 tons daily heats, and got an average ratio of 9 to 1 His results, as given, are consistent with good management. Another gentleman, giving his experience, voiced the condition of many foundries where they "think" they get 10 to 1, but have no means at hand to actually prove what they do get.

Now taking the cost of fuel to melt at 7 to 1, and taking 25 tons per day for 300 days, or 7,500 tons of castings per year, this means 3.57 times 300 days, or 1,071 tons of fuel per year. With fuel at $5.00, $5,355 is the amount consumed. With a ratio of 10 to 1 and the same tonnage, the fuel bill would be only $3,750, showing a profit of $1,605, and from the experience of the writer almost every foundryman running a jobbing foundry with one kind of iron should easily make this saving.

Here is a twenty ton heat with 43 per cent. steel scrap. 1,000 lbs. coal, and 500 lbs. coke was used for the bed. 8,200 lbs. was the first charge, with 4,000 pound charges thereafter. Eight charges being made with 375 lbs. coke between. Total fuel 4,500 lbs. The melting ratio was almost 9 to 1, and the metal had to be held 35 minutes in the ladle before pouring.

I give this experience in order to invite criticism, and hope that further data from others interested in this subject may be offered for a more extended discussion.

THE NEW Y
PUBLIC LIBR
ASTOR, LENOX AN
TILDEN FOUNDATIO

Journal of the American Foundrymen's Association.

VOL. XI. DECEMBER, 1902. PART I.

MALLEABLE CAST IRON.

BY H. E. DILLER, CHICAGO, ILL.

Much has been written of late in the way of calling attention to the rapid growth of the Malleable Casting Industry, and, indeed, not only are new works springing up in the large iron centres, but the older establishments are expanding very materially. There is little wonder at this when it is considered that the malleable casting is peculiarly adapted to the requirements of four great classes of work; agricultural implements, railway supplies, carriage and harness castings, and pipe fittings. Were it not for the fact that malleable cast iron is not adapted to the heavier sections, it would be a sharp competitor to the gray casting industry.

In its manufacture the special make of iron called "Malleable Bessemer," or "malleable coke iron," is the principal material used. The charcoal irons, though unequalled for value, being confined to the regions where they can compete with the cheaper coke irons. The Silicon should be .75 to 1.50 per cent., phosphorus under .200 per cent., while sulphur should be below .04 per cent. if possible. A pig iron, higher in sulphur, in reality an "Off-Bessemer," while meeting the silicon specifications perfectly, should not be used except in limited quantity, and then carefully watched.

With the pig iron, hard sprues (unannealed scrap), steel and also malleable scrap is charged. The latter two materials are very good to add to the mixture as they raise the strength of the casting very considerably. Care must be taken not to add too much, as this reduces the carbon to a point when fluidity and life in the melted metal is sacrificed.

"Malleable" is produced in the cupola, the reverberatory furnace, and the open hearth. The first process, under ordinary conditions, is the cheapest. The iron made is, however, by no means the best. Test bars made of cupola iron seldom run above 40,000 lbs. per sq. in., while with furnace iron there is no difficulty in getting a few thousand pounds more. The most serious objec-

tion to cupola iron is its poor behavior under the bending test, the deflection being very light.

In the reverberatory and in the open hearth, the fuel is not in contact with the metal and the result is much more satisfactory. The metal in these furnaces may either be caught in the ordinary hand ladles or it is tapped into a large crane ladle and conveyed to the distributing point and there emptied into hand ladles as required. When tapped into hand ladles, the time taken is a serious item, for the beginning and the end of the heat will be two different things. The latter iron especially will be inferior, as it was subjected to the oxidising effects of the flame much longer than the first part. As a rule this difficulty is somewhat remedied by pouring the light work first, the heavier pieces coming later, when the silicon has been lowered too much for good light castings. With the crane ladle pour the molder has much less space to travel over, and this will doubtless be the coming method.

It takes a good man in the foundry as well as in the pattern shop to handle malleable casting questions properly. The gating should be done to avoid the shrinkage effects as much as may be, while the little tricks that can be applied make a surprising difference in the molding loss. As a consequence some malleable works seldom lose more than 10 per cent., while in others 20 per cent. and over is the rule.

After the castings have been tumbled they go to the annealing room, where they are packed in mill cinder or iron ore, in cast iron boxes. These are carefully luted up, and heated up in suitably constructed ovens for the space of five or six days. It usually takes 36 to 48 hours to get the oven up to heat, the temperature ranging from 1600° to 1800° F. in the oven, the boxes having a somewhat lower temperature at the coldest point. When the fire is extinguished, the dampers are closed tight, all air excluded and the oven allowed to cool very gradually, often but 400° F. the first day. After the castings come from the anneal, they are again tumbled to remove the burnt scale, and they are chipped and ground for shipment.

The hard casting should have its carbon practically all in the combined state, while annealing process should convert this to the so-called Temper, or annealing carbon. A well annealed casting should not have much over .06 to .12 per cent combined car-

bon remaining in it. Under-annealed castings can be readily detected by their brittleness, but it takes much experience to be sure that a casting is over-annealed. There is a material difference between the strength of an over-annealed casting and a normal one. I took two bars from each of five heats. One bar from each set I gave the usual anneal; and the others I re-annealed. The average tensile strength of the first set was 50,520 lbs. per sq. in., and the average elongation was 6¾ per cent. in six inches. The re-annealed set had an average tensile strength of 43,510 lbs. per sq. in., the average elongation being 6¼ per cent. in six inches. Over-annealing had therefore cost the metal some 7,000 lbs of its strength.

The fact that malleable castings are little understood may account for the limited way in which they are specified. While some rail roads specify the mixture, composition, and strength of gray castings, they do little in the way of the malleable. One rail road for which I made castings called for 40,000 lbs. per sq. in., and an elongation of 5 per cent. in two inches, for sections ½ " and under. and 30,000 lbs. per sq. in. with a corresponding elongation of 2½ " for sections ¾ " to 1 " thick.

To show to what degree some foundries are making iron for these demands, I took test pieces from some of their castings. The tensile strength and elongation, in six inches, of these pieces was as follows :

No.	1.	35,030	lbs.	per sq. in.,	and	4.7	per cent.	elongation.
"	2.	34,410	"	"	"	3.3	"	"
"	3.	37,840	"	"	"	4 2	"	"
"	4.	45,550	"	"	"	4.0	"	"

It was also rather odd that the thicker pieces showed the better iron, for usually founders err in the pouring of heavy castings with mixtures intended for light work.

"Malleable" can be made up to 60,000 lbs. per sq. in., though this is not advisable as the shock resisting qualities are sacrificed. Yet as specifications become more severe the general quality of this class of castings will be improved until we get a more reliable article, and which can better resist the encroachments of the steel casting.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. MARCH, 1903. PART I.

THE VALUATION OF PIG IRON FOR FOUNDRY PURPOSES.

BY DR. RICHARD MOLDENKE, NEW YORK.

When I presented a memorial on this subject to the American Foundrymen's Association in convention in Boston, last June, I realized very fully that it was a radical step which was certain to be objected to by furnacemen generally. I did it to invite discussion, suggested a possible method of solving a problem which has long faced the foundryman who has to make castings for the severest service, and my only motive was to assist in raising the standard of the foundry trade another step higher.

It is very obvious that improvements should be made at every stage of the casting process. Then why not improve at the very starting point—the pig iron? We all realize that however we may specialize in our work, the jobbing foundry will always be with us, and no foundry pig iron worthy of the name need be left on the hands of its makers for want of work to cast it into. On the other hand, the founders of specialties, who have helped make this country so great as a manufacturing nation; these are entitled —nay more, should demand—perfection, as near as it can be attained, in their raw material. When they feel reasonably certain that they have the best pig iron obtainable, the best fuel, the most efficient melting processes, molding, pouring and cleaning outfits, then they will think again, and look for further economies and improvements. This is only the modern way of doing business,

superinduced by lively competition, and we are truly desirous of co-operating with the furnaces in every way possible to bringing about improved results.

It will be remembered that I proposed the study and subsequent adoption of standard methods of judging the value of pig iron for our purposes. I urged that the chemical standpoint, now so generally accepted, was not sufficient where the highest measure of quality in castings is concerned. That we cannot by chemical means trace the weakening influences of poor blast furnace practice, which may be diluted by judicious mixing with good irons, but which should be detected and the poor material weeded out absolutely for important and special work. That even the most uninformed foundryman today knows that it is useless to test iron in the pig direct, because of the wide variation in strength due to the cross section, pouring temperature, and treatment in the casting house. This outside of the furnace end of the proposition. It is therefore necessary to remelt this iron and to cast it into sufficient bars to get an idea as to its value for the work required. To do this with fairness and a reasonable chance of success, I recommended the use of a standard cupola, standard coke, standard conditions of charging, blast in fact the whole process accurately laid out, and standard test bars, possibly a dozen of them, from which to obtain the knowledge sought.

The foundry industry is much indebted to the *Iron Age* for sending out circular letters of inquiry with reference to my proposal, which, by the way, is only novel in the standardizing feature. In the issues of June 26th, and July 3rd, a number of replies are published, all of which give food for thought. In bringing out the subject, the *Iron Age* very rightly holds that the task is a prodigious one, and looks impossible, but that evidently American Foundrymen have something of this nature in mind and therefore approved of its further investigation.

The *Eisenzeitung*, of October 16, the official organ of the German Foundrymen, on the other hand, after giving the substance of the memorial, calls attention to the fact that German foundrymen have long felt the want of some such system, and urges concerted action to do something along the line indicated.

In studying the criticisms brought out by the *Iron Age*, the

interesting fact developes that there is a unanimous and settled willingness to sell pig iron by analysis. The work of our well known pioneers in foundry progress has thus revolutionized the old selling methods, for nowhere is fracture mentioned. For this much let us be thankful. No one would have thought this possible in the few years that have passed since grading by fracture was attacked. All the furnacemen on record think that selling pig iron by analysis is sufficient. They do not, however, realize that the roll maker, the founder of car wheels, the maker of malleable castings for specified tests, use several brands of the best irons obtainable, all of the proper composition, for safety; and when, in spite of this and the greatest care everywhere, the rolls crack, the car wheels fail to pass, and the couplers will not stand up, first one brand of iron is cut out and then another, and thus the hitherto unsuspected iron is weeded out. Doubtless this iron might be a very good one generally, but if the foundryman had the means of knowing that his shipments were made while the furnace was under a cloud, he would rather give away the iron than put it into large rolls. Such irons, while showing the right composition, might be so badly burned in the making that normally strong pigs will break in two by simply letting them fall on a rail. The cupola and the hearth furnaces are not the only places where iron can be badly oxidised, but this is very difficult to trace chemically.

One of my critics holds that skillful foundry practice overcomes some defects in a pig iron. True, judicious mixing will dilute excessive evils, but the foundryman is not desirous of paying full prices for this privilege. The very thing the method I proposed is intended for—the discovery of undue oxidation—cannot be eradicated by any foundry practice for cast iron we know of now.

Several critics do me the honor of holding that my proposition is correct theoretically, in fact ideal, if only possible to realize. That no progressive furnaceman has anything to fear from it, while the unprogressive one has, and depends upon a mixture of his with other good irons. It is suggested that enough bars be cast to make certain of a fair showing, and that the lines be not drawn too tight. All thinking foundrymen will heartily endorse this, for they will always give the fairest interpretation to the tests possible under the circumstances—provided they see an honest attempt to

deliver the best iron for the composition specified that can be made. I have never yet caused a single car load of iron to be removed from my yards. Whenever the standand was not met the price was revised, and the metal used for work of minor importance.

As there seems to be some misapprehension regarding the practical working of the physical test in addition to the chemical, it might be interesting to note how this will in all probability come about. The base price of a given iron will always be determined by the supply and demand, that is, ordinary market conditions. The founder who desires to have a guaranteed strength as per the test proposed, will naturally be expected to pay for it. This the founder of rolls, car wheels, malleables, government work, special machinery, and the list of other castings requiring the highest grade of materials will be glad to do. Wherever castings are made upon the strength and quality of which human life depends, there should be no question of price anyhow.

As the quantity of pig iron bought under such a test, at least for a long time to come, would be limited, there need be no serious interference with the yard arrangements at the furnaces, in fact I venture to prophesy that whenever a furnace has what is thought to be a specially good cast, it will be put to one side, tested, and the salesmen armed with the report for selling to an advantage. This is done right along in the chemical sense with irons specially suited for acid steel production. Why not then for car wheels ?

It is further held that the physical strength is not enough, but that shrinkage, scrap carrying capacity, clean and sharp surface, and the microstructure of the iron should be arranged for. This I consider entirely too elaborate, and in fact unnecessary so far as we know now. The plain transverse test is all that is necessary to show what is required when taken in connection with the composition. The contraction of an iron when in the standard test bar, is practically a matter of its composition, and that mostly in the constitution of the carbons. With the large standard test bars, adopted by the American Foundrymen's Association, the influence of the pouring temperature and the molding sand is practically eliminated, leaving the question of contraction of much less importance than was formerly thought to be the case. Of course in the absence of

chemical data, a contraction test is very essential, but we are a little beyond that point at the present day.

So far as the scrap carrying capacity of an iron is concerned I have this much to say. This is also a factor of the composition. A high silicon iron will always carry more scrap than one that is low. My experience may differ from that of others, but I have always been able to hold the same percentage of scrap with any brand of iron of my required composition. I have found no difficulty in making castings from scrap alone when enough high silicon was added to get this element right, and enough manganese to cleanse the metal. I was rather astonished when told the other day that my experience in this line was way off, as the broker in question was selling pig iron comparatively low in silicon which was actually carrying 60 to 80 per cent. of scrap. He was in turn astonished when told that the scrap was carrying his pig iron. But he was laying great stress on graphite in pig iron, and did not think the other things mattered much. All of which shows that there is still room for missionary work in pig iron circles as well as in those of the foundry industry.

We all remember the time when furnaces refused to sell pig iron by analysis. Then a premium was asked, in one case presented to me it was $2.00 a ton. Then the furnacemen yielded gracefully, and are now very glad to be rid of the grading disputes. Undoubtedly more attention is now given at the furnaces to turning out a more uniform product, big, densely graphitic pigs no longer helping out a low silicon cast. The result has been a direct benefit to the foundry trade as well as themselves. And so also will be the further improvement of the iron by increasing the demand for quality. The very earnest desire for a differentiation of the really good irons from the indifferent or really bad ones will not be thwarted by characterizing my proposal as "fundamentally wrong, unfair, impossible and undesirable." As "opening the doors to controversy. Only adapted for weak foundrymen," or asking too much "because steel men will not do it," and "foundrymen not educated enough to get any benefit from it." These tests, whether the one I proposed or other better ones, will come when furnacemen are ready to look for customers again, and then evidence of good qualities will be a good argument for sales.

It is admitted that poor foundry practice, bad fuel, or even

variations in the regular routine will bring about variations in results with the best of irons, that the character of the castings made from pig iron depends upon many conditions, but the fundamental idea remains that with good standards and fair conditions, a good iron should show up well in a remelting test. What the actual strength should be will soon be developed by the foundryman most interested, and gradually pig irons, while varying in composition from month to month, or day to day, as they come from the furnace, will not vary as much in corresponding quality as they do now.

Z, C8

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. MARCH, 1903. PART I.

THE FUTURE OF THE FOUNDRY INDUSTRY.

BY DR. RICHARD MOLDENKE, NEW YORK.

But little thought is given to the future of our industry in these brisk times of orders in plenty. Our plants are yet crowded to their full capacity. Enlargements have been the rule up to now, but the projection of new enterprises has practically ceased. The only possible exception being in connection with established plants. This, then, seems the time to analyze the conditions which will affect the future of the foundry industry to a greater or less extent.

In the first place we must see what currents we are running in, and how they are drifting us along. In general we may say that specialization has become the order of the day. At the present time at least three quarters of the foundry output goes into channels within fixed and narrow bounds. This condition is not only likely to continue, but will become the national trade necessity. Specialization as against generalization is the sharp contrast we note in comparing our industrial system with that of Europe. Every one following out his own line of production to the extreme, learns the fine points which enable him to undersell at a profit. With our natural resources and transportation facilities, it is easy to see that careful nursing of the foreign trade we now enjoy, should do much to mitigate the disasters of the hard times to come.

With the tendency toward standardization of everything within reach, the future seems to indicate a still firmer grip for us upon the commerce of the world, and as specialization of effort is really the cause of our world power, I cannot think otherwise than that specialization and standardization together should be the key-note for our industry for the future.

Looking over the likely condition of the money market, it seems as if competition for work will sharpen considerably. Founders who have made connections which secure them preferences in

the way of holding work will be compelled to drop prices in spite of this, the outsider naturally leading the procession. Every founder will therefore try to get hold of something he can do better and cheaper than his fellow-townsman. Some will succeed in this and keep their identity intact. The stronger ones will, however, be gradually drawn into working agreements with others in their line. From this actual combination is but a short step. This tendency which has made our present time one of huge industrial combination, will be still more accentuated in the future. Self defense will compel closer business relations so far as it affects the buying of materials from the great combination of other industries, and similarly the selling to the great combinations of still other industries. With these conditions properly balanced, and sufficient "independents" to make things interesting, there is not the same chance of extreme disasters in our industrial economy as heretofore.

We may therefore look for combinations in the heavy lines of foundry work, such as in car wheels, ingot molds, rolls, malleables, stoves and radiators, electrical work, and special lines of machinery. We already have working agreements, small combinations, and plans for larger ones in our industry. The tendency is therefore plain enough to see, and it will result in material changes in the actual operation of the plants.

There is a general feeling of confidence in industrial ventures, as reflected by the market for securities. Wall Street, ever discounting the future, is getting ready to list more and more industrial ventures of approved character and vast proportions, and thus facilitates the purchase and sale of securities in a bona fide way, where formerly it did so only for dynamiting purposes. While this may not be a good thing for our industry, as it usually means a lot of injected water and shaky financiering, yet it is a distinct gain to the country at large in affording wider channels for monetary interchange, and the direct necessity for capturing the foreign markets for the enormous production by capital which must earn dividends.

The result of all this is very far reaching, and is perhaps best seen in the last factor of the problem—the extreme pressure in our navy and ship building yards, and this brings us to the third item in the discussion— the labor problem.

We are undoubtedly going to face serious times with our labor conditions. Were only the interests of the foundry at stake we

might feel as if we are suffering for the good of the country. Unfortunately, however, the whole industrial system of the nation is bound to meet a crisis which will be delayed or hastened by conditions which may well give us grave concern. From the medieval times of the "Faustrecht" we have come to recognize that *Power* must be made to go with *Responsibility*. In other words, a breach of the peace, or a breach of contract is and can be properly punished in a normally constituted community. Moral wrongs, however, are perpetrated but too often, and must be met in another way.

We are daily seeing the breach between employer and employee growing wider, and this in spite of all that is done to bridge the chasm. Organizations which should naturally work in harmony are really formed to intensify the difficulty, and as between organized labor and organized capital, the crisis through which England has passed and lost its industrial supremacy, now faces us, and will next confront our chief competitor—Germany. Now what may the future have in store for us herein?

The invoking of law today, where barricades were the usual resort. The bitterness of the cry against "government by injunction" which shows that the right spot has been touched. All signs point to the will of the people, that power, whether in the hands of grasping corporations, or in large groups of workingmen, shall be coupled with responsibility. Imagine an industrial association wronging any one laborer without being sharply brought to account and mulcted heavy damages, and rightly so. When, however, an employer is all but ruined by tactics which are invariably denied but are practiced just the same by individual members of labor associations, he has the choice to fight or go under. Common justice demands that the parties of both parts be held liable to damages, and be made to obey the law without discrimination. The unscrupulous employer is just as much a menace to the country as the professional labor agitator.

We will therefore see the compulsory incorporation of organizations which aim to regulate the status of labor, and thus the "right of might" will be whipped into subjection to the highest welfare of the state. This may take some time, but it is sure to come. Our national organizations of foundry capital and foundry labor—yes, even the local ones eventually will be made responsible. Injury to the vested interests of our founders as well as breach of

contract with the men will be punishable, and eventually be of rare occurrence.

Then—and only then—will the real value of organized effort appear. And that is in the education of its constituent members. A labor union which instead of drawing up grievances and nominating shop committees, will teach its members to become more valuable to their employers, is a positive blessing to the country at large. An organization of employers which need not scheme how to circumvent impending demands and provide means to check violence and outrage to simple constitutional rights, would be a monument to the efficacy of our civic administration. Could the same effort and time be expended in improving conditions for labor in the foundry, another and most telling benefit would redound to our coveted permanent industrial surpemacy. And I predict that all this will come, in time, for it is the consequence of enlightenment and education. Only in this way will the moral wrongs of our industrial system be righted.

This brings us to another phase of the foundry labor question, and one which is more closely identified with the actual operating, the general aspect of the labor question being rather a matter of policy and finally an added expense to the buying public. The eight hour day has long been demanded, and I predict that it will come. Whether it will bring disaster to our industry, or will find us prepared to balance matters by suitable changes in our running methods, may well be worth our careful attention.

Personally, as a trained Mining Engineer, I favor the eight hour day, but—we must have three of these short days in every twenty four hours. The wise king, who held that eight hours were for work, eight for sleep, and eight for recreation, was perfectly right. It took many centuries to come near his ideal, but it will not be many more years before this is attained. However, if labor is to receive high returns for short hours, capital is no less entitled to take as heavy an income as these highly paid short hours can be made to yield. When I say that capital invested in the foundry should yield interest for twenty two and a half hours out of the twenty four, nearly every foundryman will throw up his hands and say, impossible! And yet this is exactly what many of them will have to arrange for or go out of business.

Do you note the general inquiry with reference to running the cupola continuously? You may not be aware that many foundries are already running two shifts and could easily arrange for three if there were molders enough available. The arbitrary arrangement of the apprentice question is bound to take a fall in the near future, and molders, good ones and plenty, will take work where it is offered. The solution of the whole future of the foundry lies in the molding machine and men with better all around foundry education.

Probably nine founders out of ten will tell you that night work is no good. I have never found this to be the case, but always enjoyed the sight of floor upon floor of molds ready to pour the first thing in the morning. With plants as light at night as in the day time, with proper organization, and short hours instead of the usual eleven hour night shifts, wonders of work can be accomplished.

That this is not theoretical may be seen from the actual fact that in the lumber industry the night gang is always able to turn out more material than the day men, hour for hour. There is not the necessity to take in dog fights, gossiping, and the like, which is very detrimental to a continuous and strenuous output. In the mines, where it is night all the time, no difference in the rate of production is noticed, and here we find a little point which is of value to the foundry. One of the chief interferences with effective night work is the objection that molders on four or five day molding jobs have to letting others continue their operations. Suppose now, that the half dozen men who would be involved were given a contract to turn out the job properly, this difficulty would fall away at once, for no one has yet seen competent and friendly molders refuse to pound the sand together on the same mold. This is what we find in the mines. The particular stope may have two or three parties of men at work at the same time alternately. At a stated period their stope is measured up by the captain or engineer and a lump sum, as per contract, is handed out.

Why can this not be arranged for in the foundry? Does it come under the ban of piece work? If so, the sooner it is straightened out the better, and many a foundry can turn out fifty per cent. more work for the same floor space.

The only other objection of account we meet—that molders want to pour their own molds—is cared for by continuous pouring.

Now I predict that something along these lines will come

sooner or later, and if the foundry industry, which is looking very closely into the recent experiments with double turns, is sufficiently alert, the coming eight hour day need not be feared very much.

In concluding the labor questions mentioned, I cannot refrain from adding a few remarks on the industrial capacity of the country at large, and the foundry in particular. We only build immense plants. We are enlarging the old ones to an extent which really means further immense plants. We have them full today, and nearly deserted tomorrow. This is not political economy, and means that when the hard times do hit us, that we take work at less than cost, to keep up our organizations. Many a nice fat surplus is wiped out in the hard times. This is not right, and perhaps the three eight-hour-shifts mentioned above may help to solve the difficulty in a measure, for a smaller plant will do for the normal output, a tightening up of conditions is met with cutting out one shift, and hard times with one turn, or even less, at work, where otherwise a vast establishment will run short handed three days a week.

Already we have some nine and one half hours only of the twenty four put in at actual production, the balance of the day sees the machinery idle, while the company's notes are piling up interest. With the eight hour day things will be worse unless steps, such as I have indicated, are resorted to. We would therefore see a plant necessarily three times as great in the lay-out as need be, and practically three times the capital tied up in it, two thirds of which is doing nothing, in fact costing interest. What could not be done with this vast amount to enrich our great nation still further.

As we look over our shipping blotters and note the effect of a holiday on the month's sales, we wish there were none of them. The same may be said for many of our men in the shops. Of course, I do not mean to advocate the abolition of our holidays, but I wish to point out what it means to have many of them when taken in connection with the size and cost of a plant for a given production or tonnage per year. We can thank our stars that our most dreaded competitor of the yet distant future—Russia—has some fifty holidays in addition to ours, which means a correspondingly increased capitalization and working cost when compared with ours. No wonder that it is only a question of time when American enter-

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

prises there sell out to the natives or come home.

In this aspect, perhaps, we find also a reason for consolidations, as the ultimate destination of many of the plants thus absorbed is the scrap pile. It will pay us to watch developments in the way of "over-capacity" very closely, and the future may have many strange developments in store for us herein.

Perhaps the last thing to touch upon, and yet the one matter which we will meet first, is the future development of the foundry equipment. This would form a topic upon which discussions may be held by the hour. Suffice it to point out two things. The molding machine, and conveyors. Every thing else, as well as these, is wrapped up in the policy the foundry will be forced to adopt in the near future. I have outlined this policy, as I see it, in what has gone before, and need therefore add but little. Specialization means the molding machine with a vengence. Consolidation gives the sinews of war to adapt, adopt, and force their systematic use. The breaking up of restrictions regarding apprentices means more and better men to do the other molding. Conveying systems mean the systematic production of castings, outside of the molding end, at minimum cost. Continuous molding, pouring, and in fact continuous work in the foundry based upon short hours with good pay, means getting the best efforts of the men, contented men, and a prosperous country. Naturally the study of the foundry in all its details will not cease. Standardization, improved work, uniform customs, we might say—the millenium, minus the human end, which we will never fully control or correct; all things which help to make foundrymen reasonably content with their life work—all this lies in the future for us.

But we must not be idle in the meantime. If long association with the labor end of the foundry as well as the financial, counts for anything, I feel that we must do our utmost to place within reach of the youngest apprentice the means by which he can receive a good general education as also the special one for his trade. We owe this to our nation as well as to the industry that has made our fortunes. With all the difficulties that loom up in the labor problem, I feel that we have nothing to fear from the man who from his youth is looking forward to his own home, his savings account, the education of his children as useful citizens, and his peaceful retirement when old age comes on. This man, the back bone of the

nation, has had no difficulty to realize his ambition heretofore, and will not have it in the future, as consolidations, instead of cutting him out from opportunities, will give him the chance to become a stock-holder if he desires, and by reducing the severity of hard times, keep him in steadier employment. Men of this stamp, I am glad to say, are still the vast majority of the laboring men of today. Let us help them to help themselves by education, and the future of the foundry need give us no concern.

Journal of the American Foundrymen's Association.

VOL. XI. APRIL, 1903. PART I.

THE MELTING RATIO.

BY JAMES A. MURPHY, ERIE, PA.

Many foundrymen have gotten into the habit of talking high melting ratios to such an extent that the more inexperienced proprietors are led to think that their foremen are simply robbing them, when one to six or seven is the rule in their establishment. And yet a better ratio may be impossible to obtain when certain classes of work are to be gotten out properly. I do not believe in saving coke at the expense of castings, but this is just what many foundrymen are doing, and many more have done.

A few years ago I saw the efforts of the superintendent of a large Eastern foundry to melt at one to ten, with the natural failure that resulted for the particular class of work he had in hand. During two months of this trial, three steam cyclinders weighing over 20 tons each, not to mention many tons of the smaller castings, were thrown out by the machine shop. All this work was lost because of dull iron. There were also many tons lost in the foundry which never passed the drop.

Now there is no doubt at all that iron can be melted at the ratio of one to ten, *for certain kinds of castings*, and when anyone speaks of melting iron thus, it would be well to pin him down to facts. To ask him whether the coke and iron was accurately weighed. What the height of his tuyeres is from the cupola bottom, the height of charging door, diameter of cupola, and blast pressure. What percentage of pig iron, scrap or steel goes in. Whether the pig and scrap was large or of normal sizes, whether coal was used with the coke, and the quality of each. Finally what was the class of work to be poured and the length of time necessary to accummulate enough metal to pour the pieces.

Information of this sort would be useful in making comparisons, even though conditions are seldom alike in any two foundries. One establishment may have a cupola of an improved type while the other would be struggling along with the old time home-made

affair. I have on some occasions melted iron cheaper in the air furnace than in the cupola, but it would be folly to assert that the air furnace process is the cheapest. Extra good conditions governing a "heat" in the air furnace or cupola are no criterion by which to judge or guide others.

Here is a heat of 16¼ tons taken off under pretty favorable conditions. The coke was excellent and the pig iron and scrap of normal size. In the first three charges there were 35 per cent steel clippings, the other charges ran 50 per cent pig and 50 per cent scrap. The height of the tuyeres from under side of sand bottom 14". Height of charging door 9 feet, pressure 10 oz. Bed of coke 700 lbs. First charge 2,500 lbs. iron and 200 lbs. coke. Each succeeding charge had 2.000 lbs. iron until the last, when 100 lbs. coke only was used. This was in the summer of 1901.

During the greater part of 1902, I could not melt a ten ton heat better than one to seven and eight tenths, and smaller heats often down to five and three quarters. This was a great reduction from one to nine as shown in the in the first example mentioned, but the quality of the fuel was responsible for this. Had I kept up my melting ratio, I would have lost many castings, and as these were engine and other particular castings, they had to be sound and perfect in every detail.

I am a firm advocate of economy in our foundries, but believe that in many instances the saving of fuel to give higher melting ratios, is equivalent to saving a gill at the spiggot to lose a gallon at the bung-hole.

JOURNAL OF THE

AMERICAN FOUNDRYMEN'S

ASSOCIATION.

PROCEEDINGS.

VOL. XI. PART II.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

What may be truly called the most successful convention ever held by our Association, took place in the historic city of Boston. Through the unbounded hospitality of our New England friends, we were warmly greeted at the arriving station, safely conducted to headquarters, supplied with full information and seen safely and comfortably settled for the period of our visit.

A programme of entertainment was provided which filled every moment not required for the business in hand, and left nothing to be desired in the way of solid enjoyment, coupled with a most admirable forethought to even the smallest detail.

Long will we remember the imposing line of Boston's best coaching outfits as the column two miles long swung around the curve leading to the Arsenal grounds. Then later the visit to the cleanest foundry we ever will be permitted to see. The elaborate entertainment there. The return home through old Harvard and the beautiful suburbs.

Again those of us who were rounded up in the old church and had the doctrinal differences of our ancestors properly ventilated, nevertheless appreciated the spirit which must have moved those sturdy heroes who knew not what an epoch they made when forming the famous tea-party.

The delightful theatre party, the smoker, the most enjoyable trip down the harbor. The elaborate fish dinner there. In fact everywhere and at all times we were in the hands of our friends who left nothing undone to charm us all with their courteous care and attention. Our ladies who attended in goodly numbers, as well as we ourselves will remember the time as one of the brightest, most agreeable, and with all profitable events of our lives.

We can therefore do no better than return our hearty thanks right here and assure our New England friends that what they have done for those of us who were fortunate enough to attend the convention, will find its appreciation also by the trade at large, and new life, vigor, and purpose will come to our efforts in the special field our chosen work is in.

Journal of the American Foundrymen's Association.

VOL. XI. JULY, 1902. PART II.

PROCEEDINGS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION, IN CONVENTION AT BOSTON, MASS., JUNE 17, 18 AND 19, 1902.

Through the courtesy of the authorities of the Massachusetts Institute of Technology, the seventh convention of our Association was held in Huntington Hall. The opening meeting was called to order by the Secretary at 10 A. M. Tuesday, the 17th of June, 1902.

The Secretary: Ladies and gentlemen, members of the American Foundrymen's Association: It is my painful duty to call the meeting to order, because, as you know, of the sad and tragic death of our President, Mr. Sadlier. Our acting president, the senior vice president, Mr. Colvin of the New England States, has preferred not to take the Chair, because he feels that some one other than from New England should do so at this meeting, and therefore I will call upon Mr. Walter F. Prince, the Vice President for New York and New Jersey, to do so.

Vice President Prince. Gentlemen of the American Foundrymen's Association: It is very sad that the Chair cannot be filled by our President, but, if agreeable to you all and in accordance with the constitution, I will endeavor to do the best I can. Our Secretary has stated that our first vice president thought it better to have some one from out of the district preside. I thought this was a chance for me to keep in the background, as, if anybody has a claim on Boston I think it is myself. I was born, brought up, and started in the foundry business here, and think that this would entitle me to freedom from the cares of a presiding officer here. I will however do the best I can. The meeting will now come to order, and I beg to present to you Mr. H. A. Carpenter, the president of the New England Foundrymen.

Address of MR. HENRY A. CARPENTER.

Mr. President, Ladies and Gentlemen, Members of the American Foundrymen's Association:

I have been requested, perhaps on account of my connection with the New England Foundrymen's Association, being

its President, to extend just a few words of welcome to you, and to try and endeavor to make you feel at home. It is my privilege also to be the President of the New England Foundrymen's Entertainment Association, an organization that was recently formed for the purpose of providing entertainment for this assembly. The results of our undertakings you cannot tell until Friday morning, perhaps, and then if pleasant memories fail to exist in your minds, and if they fail to continue to exist, we will feel that we have not succeeded in what we have attempted to do. We ask your co-operation in and prompt attendance at the various forms of entertainment which we have provided and which are outlined in the programmes that you have already received. It is necessary for you to signify your acceptance of the various entertainments as provided at a very early date to enable the Committee to make the proper arrangements.

And now, on behalf of the New England Foundrymen and of those connected with the allied interests, I want to extend to you, one and all, a hearty welcome. Let me assure you that we thoroughly appreciate your coming, and that the pleasure we have anticipated in making the arrangements and carrying out the features of the programme will be greatly enhanced if we can succeed in interesting you. The value of this convention depends wholly upon the individual. We must admit that our trade is the least developed, or among the least, of any of the trades at the present day; but assemblages of this character, where earnest men and specialists in various lines give us the benefit of what their experience has taught them, must have a telling and lasting effect upon the foundry industry, and must also exert an influence on some of us to wake up to modern methods and strive to achieve that success which awaits the vigorous, the up-to date and hustling foundryman.

The original promoters of this organization need congratulating on the success that has both directly and indirectly attended the results of their forethought. Since its inception various organizations and associations have been formed, and the effect has been the wide expansion of our industry and many improvements in the methods and the opportunities presented to all foundrymen, whether members of the American Foundrymen's Association or not, to interchange ideas and to profit by meetings of this character.

I thank you, Mr. President, for the opportunity to say these few words, and I again bid you all welcome to old New England, and trust that your stay with us will be instructive, enjoyable and beneficial. (Applause).

Now, Mr. President, it will give me pleasure to introduce a representative of the ctiy of Boston, who will also say a few words of welcome. It is my pleasure to introduce Mr. James H. Doyle, chairman of the Board of Aldermen, of the city of Boston.

Address of MR. JAMES H. DOYLE, of the Boston Board of Aldermen.

Mr. Chairman, Gentlemen of the Convention: I have been delegated by His Honor Mayor Collins to represent him at this convention. I know that I cannot begin to speak for the city as well as Mayor Collins could, but, as his absence is unavoidable, I trust that this convention will accept me in his place as representing the city of Boston, and will at least give me the credit of being willing, if not so able.

I shall not detain you long, as I am not an orator. However, it gives me great pleasure, in behalf of the citizens of Boston, to welcome such an aggregation of business men and employers. You are the men who make industry possible in this country, and your branch of the mechanical business is one of the foundations which make the great manufactories and give employment to so many hundreds of our citizens. It occurs to me also that you must have always treated your employees well, as I have never yet heard of any serious labor difficulties in which your association or employees were involved.

Gentlemen, If I had the power I would wish to have you all come to live in Boston. We need people like you. You are the men who make business good. You spend money, and your employees spend money. You employ men, and men are the foundations of this great republic. In your industry you must have men—and when I say men I mean manly men, and not callow specimens of the race. Many of you have doubtless worked up from the lower branches of the business, and that shows to my mind what industry and application is capable of in this country. Again, I extend to you the greetings of the City of Boston, and I trust that you may all be prosperous in business as well as in health. You need your employees, and they need you. When we die we cannot take any of our earned or un-

earned increment with us, so let us give our brother men a helping hand, and we will feel better and probably die no poorer.

I thank you for your attention, and hope and trust that you may all leave Boston with good feelings towards the town known as the Hub, and a town which always likes to extend its hospitality to such a representative body of men as yours. (Applause).

Mr. Carpenter: Mr. President, I think we have been exceedingly fortunate in having given to us for the purpose of holding our sessions the facilities that this Institute affords, and it will now give me pleasure to introduce to the assembly Prof. C. F. Park of the Massachusetts Institute of Technology.

Address of PROF. C. F. PARK.

Mr. President and Gentlemen: It gives me much pleasure to extend to the Foundrymen's Association, on behalf of the Massachusetts Institute of Technology, a hearty welcome. We are pleased that you are meeting with us, and we gladly extend the use of our hall and all other hospitality to so worthy an organization. It seems quite fitting, that education and practice can be allied in this annual convention, for in this age scientific education and practice must go hand in hand. We hope that you will feel at home with us in any of our buildings. We hope that you will feel that while you are here this hall is yours, and that our laboratories, which will be opened for your inspection, are free for your use. According to your programme, our engineering laboratories will be open to your inspection to-morrow morning. This is one branch of our technical training that we feel is perhaps of particular interest to men of your attainments. We trust that you will feel free to visit us at any time, and we will be glad to take you through any part of our institution. (Applause).

Vice President Prince: Gentlemen, I will call on Mr. Bell to respond to the welcome extended to the American Foundrymen's Association here.

Response of MR. C. S. BELL.

Mr. President, I think it is proper and right that we should

express the gratification that we all enjoy in being so cordially invited, in the first place, and then so cordially treated this morning. There is no place, probably, that would be so interesting to a foundryman to visit as the city of Boston. We were delighted when we learned that we had an invitation here, and we certainly feel highly gratified this morning to know that we are here, and we convey to these gentlemen who have been so kind to explain the situation how much we appreciate what they have done and what they propose to do. Now, while it is true that probably all foundrymen will not be able to get into the pearly gates in heaven, there is one thing they will be glad to remember as they go down the stream of life, and this is that they have had the privilege of visiting Boston. (Applause).

Vice President Prince: Gentlemen, the first business before the meeting is the reading of the Secretary's report, I believe.

REPORT OF THE SECRETARY.

Another prosperous year has been given to us, wherein to consolidate our resources, improve our plants, and plan new developments in our ever increasing industry. The difficulties encountered lay in getting material rather than orders, all foundries abreast of the times making money. As the foundry industry consumed over three and one-half millions of tons of pig iron, besides the proportionate amount of scrap, in the last fiscal year, and iron has averaged at least $15 a ton during that time, there is little wonder that with such enormous sums involved, and these distributed into every nook and corner of this great land, the foundry industry is looked upon as a good barometer of the general business condition of the nation. With indications pointing to a still further advance in pig iron through increased consumption, many of our foundrymen are contracting for next year's delivery, and fortunate are those who have covered their this year's requirements at fair prices.

Our Association seems to have experienced a similar change to a more prosperous condition, the latter half of the fiscal year just closed, indicating an interest so marked that our members

have every reason to be proud of the standing being acquired by it in one of the numerous lines of the industrial development of the world. There is an unusual amount of interest manifested in the study of cast iron. Those industries into which large quantities of castings enter, making close enquiries about their quality. The molder's art is beginning to be recognized as one which is most intricate and important, and there is a general inclination to place the molder himself upon the plane of a highly skilled workman who should not waste his time and his employer's money by performing unskilled labor.

Perhaps the close economies effected in the steel industry by utilizing the highest skill obtainable, or in other words, by paying for brains well directed, has left an impress on our own methods, for we also are beginning to demand the greatest production at the lowest cost, and are furnishing the best of facilities and paying the best of wages to do it.

There have been many changes in the membership of our Association. Death has reaped a harvest, and removed many men most useful to our industry. The sad and tragic death of our worthy president, Mr. John J. Sadlier, was, perhaps, that least expected by us all. Hale and hearty while at our last convention, full of the fire of life while discussing the molder of the future upon the floor of the house; honored by founder and molder alike, he fell by the bullet of one of the very artisans he had helped to make. Appropriate action was taken at the time by our Executive Board, engrossed resolutions expressing the profound sorrow of our members for the man they had honored with the presidency, were conveyed to his bereaved family. The general wave of sympathy, finding its expression even in Europe, showed that his efforts to better the standing of the foundry, as well as uplift the men employed in it, were thoroughly appreciated.

In spite of the deaths, resignations, removals from the list, and consolidations, we can record a net increase of 17 names, making the total membership 314. The tide turned during the last few months of the year just closed, and was aided by the addition of members from England, Scotland, Wales, Germany and Holland. Inquiries from Denmark, Russia, South Africa, and even India, may result in extending the usefulness of our As-

sociation into those fields, and go to show that the world is taking note of American foundry practice, and is presumably wondering how we can afford to be so liberal with our information.

During his recent travels in Europe, your secretary met with many of the foremost directors of industries, State officials, financiers and scientists, and nearly everyone exhibited the liveliest interest in American methods of procedure, in our national resources and transportation facilities, and in our declared national policy. There were a few who affected to look down upon us with the scorn bred of centuries of industrial security, but who will none the less live to rave at the "American Peril" when we cut into their holdings. Everywhere cast iron was the topic of general interest. Your secretary, whom you so kindly accredited to represent our Association abroad, found it well known everywhere through its work, even if he did have to translate its name into several languages to enable the enquirers to watch specially for the proceedings in the technical press of their respective countries.

At the Buda-Pest congress of the International Association for testing materials, the study of cast iron was ably urged by the only three American members present, and each of the three is directly interested in a foundry. The result was the making of tests on cast iron a special feature of the work mapped out, and much will doubtless be learned by the associated effort of the many nations interested. Our own American Association for testing Materials, of which we are members, in its convention last week, devoted one entire session to reports on, and the discussion of, cast iron. The committee appointed by them to codify the matter of specifications will doubtless utilize those adopted by us last year to the best possible advantage.

On looking over the work of the Association for the past year, you will have noticed that it was very much in line with progress. The fact that we are nearly all foundrymen, and therefore with interests to conserve, has not prevented us from urging better methods to obtain better results. We are more interested in furnishing our customers with the best of castings than they may be willing to give us credit for, as we have to hold a field which the requirements of the times is making more and more difficult to care for. Our national economy will not long tolerate

the production of great weights of inferior cast iron when comparatively light steel castings will do at least as well. The watchword is now to put the best of material into the best made castings, in great quantities and at extremely low costs. There is little wonder that the excellent papers on the molding machine now being published in our Journal are attracting wide attention. We hope they may be extended a long time yet, and be made most exhaustive, so that a foundation may be laid upon which even future generations may build. We have also to thank the technical press, as well as the great engineering associations for the interest taken in our efforts for foundry betterment, in which they have given us substantial aid.

Your secretary begs to report further that the change of time provided for the payment of the annual dues has been effected. While this has cut off one-third of the income of the Association for the year, yet it has placed our finances on a sound footing, no advance dues being now taken to pay bills in arrears. The Association will therefore hereafter pay as it goes, and can regulate its expenses properly. The fact that there were no outlays whatever incurred by the Association during the absence of the secretary in Europe, helped to tide over matters, and it is hoped did no injury to our members. The financial statement will be found in the report of the Treasurer. Briefly summarized the figures are as follows: Total income for the year, $2,353.98; total expense, $2,352.62; leaving a balance of $1.36 in the treasury; no bills outstanding; the Association free from debt, and with as bright a future ahead as the members wish to make it by the extent of their substantial support. This excellent showing is, however, in a great measure due to the work of the Standardizing Bureau, the profits of which went into the treasury. Our special thanks are due Mr. West for the disinterested manner in which he has devoted time and money in the furtherance of a work now everywhere recognized as of great value to the foundry and the steel industries.

From the item of $250 for postage, it will be noted that the office work of the Secretary has been nearly doubled, but the good results have well repaid the additional effort this caused. There has been a great call for back numbers of the "Journal," especially by the libraries of our Universities, the government, the

public foundations and foreign sources. The supply is getting limited, and some of the pamphlets which were printed in two editions are already exhausted. Our "Journal" has been enlarged and only a press of other duties prevented it from taking an even more extended shape.

Our Institutions of learning have not been idle in the matter of devoting time to the study of foundry problems. Besides a large correspondence with the professors most interested, your Secretary, as well as our Mr. West, have recently addressed the students of several of our largest universities on foundry matters.

There are two further subjects to which our Association might do well to give a substantial encouragement. The study of the electrical properties of cast iron, in conjunction with Purdue University, as reported to you last year, but not acted upon further on account of lack of funds. Then American support is most urgently needed by the Sidero-Chemical Laboratory established in Switzerland, for international research in the very lines which will be of the utmost value for the standardization of methods of the laboratory. Should we get into the position that something can be done for these matters a substantial impetus for foundry progress will result in at least those immediate lines.

The work of the various committees has been assisted as far as possible by your Secretary, who, in conclusion, wishes to thank the many members of the Association for the kind expressions of appreciation extended, the earnest help given, and the faith in the aims and ideals of our co-operative effort held forth, all of which has made him feel that the good will of the whole iron industry is with us in our chosen work.

Respectfully submitted,

RICHARD MOLDENKE,
Secretary.

Vice President Prince: Gentlemen, you have heard the report of our Secretary. What is your pleasure?

Mr. Slocum: I move that it be adopted and that a vote of thanks be passed, Mr. Chairman. (Motion was seconded and adopted).

Vice President Prince: The next business before the meeting is the reading of the Treasurer's report.

TREASURER'S REPORT.

Balance	$ 68.31	
Cash remittances from Secretary	2,285.67	
		2,353.98
Amounts expended.		
Sundries	$ 40.13	
Salaries	900.00	
Printing	105.85	
Journal	958.30	
Postage	250.50	
Standardizing Bureau	97.83	
		$2,352.61
Balance in Bank, June 6th, 1902		$ 1.37

Respectfully submitted,

THOS. D. WEST,
Treasurer.

Mr. Seaman: Mr. Willis Brown, who is Chairman of the Auditing Committee, not being present, I have been requested to present the formal report

REPORT OF THE AUDITING COMMITTEE.

We, the undersigned, a committee appointed at the last meeting of the association to audit the accounts of the Secretary and Treasurer, beg to report that we have found the accounts correct. (Signed.)

WILLIS BROWN,
J. S. SEAMAN,
WILLIAM YAGLE,
Auditors.

Vice President Prince: You hear the Auditors' report. What is your pleasure in regard to the Auditors' report? Is it that it be approved and accepted?

(Motion made to accept the Auditors' report, seconded, and adopted).

Mr. Seaman: Mr. President, it is a very easy matter for an auditing committee to make a report when the treasurer or secretary puts things before them in such shape that all they have to do is to cast up the figures on two sides and see that the balance is all right. I would, however, like to add something right here. We all know that when Dr. Moldenke took hold of the secretaryship of this association the organization was very largely in debt. We all know that the secretaries of this organization since its formation have been under a salary. We know that Dr. Moldenke is entitled to a salary just as well as anybody else, and more so, from the fact that I think if our former secretaries spent five hours in a week in the work of this association Dr. Moldenke has spent about five days. If there is any man entitled to his salary I think that Dr. Moldenke is. All I want to say to this association, and more especially to its Executive Board, is that Dr. Moldenke has not had his salary. He makes a report here that we have $1.35 in the treasury. Now, you can draw your own conclusions. I want to see action taken on this matter, notwithstanding what our Secretary may get up and say—I know that he is just itching to get up—we owe him $700 and he is entitled to it, and I think he should be paid. I want to see somebody appointed to devise ways and means for us to pay this salary, and more that it be referred to the Executive Committee of this organization. (Seconded and carried).

The Secretary: I wish to give the members an explanation. When I took the secretaryship there was some $600 debt in the association, which debt I immediately proceeded to wipe out by using the moneys that came in, paying the bills and letting my own salary; which, by the way, includes all the expenses connected with the office, and is $100 a month, stand. At the end of last year matters had been so arranged that all the debts were paid, excepting $600 owing to the Secretary. By the change in the constitution the payment of the dues was made to cover all periods up to July 1st. Therefore, in sending out bills during the year, everything was calculated to bring the payment up to July 1st, which means that the first month brought the full $10 and the last month brought only $1. Therefore in my report you notice I say that one third of the income of the association was wiped out for that year, because we stopped all the advance

payments and brought everything up to the 1st of July. I did not mention the fact that there were seven hundred dollars owing to me at the end of the fiscal year, for a simple reason, that I took a voucher and donated this money to the funds of the association to put it on a good financial footing; and that I hope will stand. I simply gave my work and my goodwill to the association for the benefit of the trade.

Mr. Seaman: I object to that part of it.

The Secretary: I may say further that present conditions are as follows: From the 1st of July we will have the full income for the year available, and at the end of the year all expenses, the expense of the Secretary's office included, will be paid, I think, all right, if all our members stay with us.

Mr. West: Mr. President—There are six other reports upon which action should be taken, and I would be glad to have them acted upon as I proceed with them, as I am liable to be called home at any time on account of sickness. The first report is that of the Standardizing Bureau.

REPORT

On the Operations of the American Foundrymen's Association Standardizing Bureau

Your committee begs to report that the sales of the Association's Standardized Drillings continue as large as during the last three years, and that this work is becoming of constantly greater importance as shown by a very much wider distribution.

Not only are the blast furnaces and laboratories dealing with cast iron utilizing our drillings for their daily standards, but where disputes arise concerning the accuracy of individual work, our Standards are sent for to settle them. Thus the purpose for which the Bureau was originally created has been fully accomplished, and the iron industry has acquired a very material help toward a better basis for the daily routine.

During the past year a second lot of sample "D" has been made. We can also state that the Bureau is now in position to furnish the trade single bottles of samples "A, B, C and D," to cover those cases where the sets of three or four bottles, which sell for $5.00 and $6.66 respectively, are not desired.

The drillings can be obtained by addressing the chairman.

Through the efforts of one member of our committee a substantial reduction in the cost of analytical work has been secured for the trade, and this from two reliable laboratories in Pittsburg and Cleveland. Silicon, sulphur, phosphorus and manganese determinations at 40 cents each; and the carbons in iron, and sulphur, carbon, and ash in coke at 70 cents, are the quotations made, with rebates on a sliding scale where two or more determinations per day come from the same firm.

The addresses and other information can be obtained from the chairman.

The accounts of the Bureau up to date of June 1st, are as follows:

Total expenses to date	$ 707.80
Collections to date	1312.77
Bills receivable	57.30

Drillings on hand—190 pounds.

All of which is respectfully submitted.

Thos. D. West, Chairman, Sharpsville, Pa.
Richard Moldenke, New York,
James Scott, Pittsburg, Pa.,
P. W. Gates, Chicago, Ill.,
E. H. Putnam, Moline, Ill.

On motion the report was received and the committee continued.

Mr. West. The next report we have is that of the Committee on Standard Methods of Sampling Pig Iron.

REPORT ON STANDARD METHODS OF SAMPLING PIG IRON.

In conformance with the instructions received at the last convention, your committee begs to make its report on a standard method of sampling pig iron for foundry purposes.

In his memorial to the Association, urging standard methods of sampling, Mr. A. L. Colby emphasised the necessity of this action in order to avoid unnecessary complications between furnacemen and founder. Your committee, after studying the matter, has come to the conclusion that inasmuch as the furnaceman has the burden of the trouble to bear in case of rejections, it

is in his interest to see that the various car loads of iron he sells are sampled by the purchaser in the fairest manner possible.

Your committee did not think it wise to specify the manner in which a furnaceman should sample his casts, interesting as it may be; for we are solely concerned with the particular car load which comes to us, and have no means of knowing how many furnace casts may be mixed in it accidentally or otherwise.

We further recommend that the method to follow be adopted provisionally only, in order to give the furnaces an opportunity to give us the benefit of their experiences during the coming year. Your committee can then report finally.

Respectfully submitted,

Thos. D. West, Chairman,
Richard Moldenke,
James Scott,
P. W. Gates,
E. H. Putnam.

SPECIFICATIONS FOR SAMPLING PIG IRON.

1. Eight pigs shall be selected from each car load of iron, two each from the upper and the lower portion of each half of the car. The eight pigs, being of the average size and weight of the shipment, will be fairly representative of the whole.

2. These pigs are broken in such a way that a piece of convenient length showing a clean fracture is available. The eight pieces are placed in a suitable box, and this duly marked with the car initial and number.

3. The freshly fractured and clean face of each piece is now drilled in two places half way between the centre and edge, a drill of large diameter being used. From the heap of drillings surrounding the drill enough is taken for the purpose wanted, and placed on a sheet of glazed paper, the drillings are thoroughly mixed and preserved. In case of dirty or excessively sandy iron the magnet should be used on the sample before analysis, for additional safety.

4. Sufficient drillings shall be made to afford material for exchange with the furnace laboratory, as well as with a possible

subsequent checking with the American Foundrymen's Association Standards.

5. The allowable variation from specified compositions shall be as follows: For Silicon, 10 points either way (plus or minus 0.10 per cent.). For Sulphur not over 0.005 per cent. above the determinations, in case of a dispute, to be made by the oxidation method. For Manganese, 10 points either way. For phosphorus, not over .05 per cent. above for all irons running over .30 per cent. Below this the variation shall be a matter of special agreement. For Total Carbon, if specified at all, the variation shall be a matter of special agreement.

6. The variation of the check determinations between foundry and furnace, as well as with the American Foundrymen's Association Standards, shall not be over the following: Silicon, .05 per cent.; manganese, .05 per cent.; sulphur, .005 per cent.; phosphorus, .02 per cent., and total carbon, .05 per cent.

The Secretary: Mr. President, I would like to say a few words in connection with this report. These specifications are drawn up, as the report states, for discussion during the year and possible adoption at the next convention. The report includes quite a lot of material, which will want to be digested pretty thoroughly, and which may possibly give rise to some opposition; but at the end of the year we will be better able to report finally. For instance it would be a question whether the method of selecting the pigs and drilling them suits the furnaceman. He is the man who suffers if we throw a carload back on him, and he also is the man who would like the fairest way to be used when his material is sampled. Then, again, the allowable variations in the specified composition. If you buy a carload at 2.50 silicon and get 2.60 or 2.40 that ought to be good, but if you get 2.75 or 3 per cent. that ought not to go. It is the variation that may be allowable in the specifications which will be finally adopted that we want to get settled. Then, also, the variation of the actual analysis. For instance, the furnaceman and foundryman may dispute about the correctness of a determination. They will send for the American Foundrymen's Association standard samples—and this has been done many times, have them analyzed by the two chemists to check themselves, and on this will depend the rejection of many carloads of iron. But

even there there must be a variation. Two chemists cannot agree absolutely. But we give the limit, and give it now, so that it can be talked over during the year and then settled. If we then can report something for adoption, it will be a substantial advance in the trade relations between the furnaceman and the foundryman.

Vice President Prince: This is a very vital point, and during the coming year it should be given a great deal of thought. I think that it is very necessary to determine the exact amount that we should have of silicon, sulphur and phosphorus. While we may know what we require to meet our different specifications, I think there is a chance that we may be compelled to pay a little more for pig iron if we are too close.

Mr. Conlin: I move that the report be received and placed on file, and that the committee be continued for another year.

(Motion seconded and adopted).

Mr. West: The next report we have is that on the Grading of Pig Iron by Analysis.

REPORT ON THE GRADING OF PIG IRON BY ANALYSIS.

Your committee begs to report that in view of the developments brought out during the discussion of this matter at the last convention, a very evident leaning being manifested toward the purchase of pig iron, simple by its analysis, irrespective of the question of grading by fracture, particular pains have been taken to inquire as to the extent to which this is actually the case in present foundry practice.

It was found that with the exception of the jobbing founder practically everyone else is now specifying the composition of the iron he buys, or else is particular to find out what he does get. For these founders, who consume about three-fourths of the pig iron sold to foundries, the labors of your committee would be superfluous. For the jobbers, however, who are in the great majority, so far as isolated small shops are concerned, much good could be done, and doubtless has been by the agitation the subject has received. Unfortunately we must report that there is no interest to be observed from that direction, very

few of the several thousand jobbing foundries being members of our Association, or interesting themselves in the elevation of their trade. These foundries will continue to buy their No. 1 and 2 irons by fracture, irrespective of what they really get, will have their little troubles and get over them as heretofore, and receive the leavings of the founder who buys by chemical specification, and sees that he gets what he wants. Your committee does not see that it can be of any use here either, for the present, beyond agitating for closer lines on the composition of the different numbers now in the market, a work which it believes is quietly going on.

Since the feeling in our Association seems to be in the direction of exact methods of buying iron, the majority of founders, not members of our Association, do not appear to be interested, we would suggest that our committee be discharged.

Respectfully submitted,

Thos. D. West, Chairman,
Richard Moldenke.

Mr. Bell: Mr. President, after the reflections of friend West on the jobbing foundryman I want to say this: The jobbing foundry has a great deal to contend with, and if its business was vast enough to justify chemical analysis for every grade of iron that it buys or wants it would be a very great undertaking. A jobbing founder has to have many kinds of iron to make the different kinds of castings that he must turn out. As a rule, he is of the old school. He knows an iron when he sees it pretty well, and it is not easy to fool him with any kind of fracture or analysis. For the reason that he requires these different varieties it would be very much of a complication to go through the methods suggested in the reports. The jobbing founders will have to jog along in the old way very much, not because they are not producing what they want, but because they are producing what they want in the way they are competent to do it. It might be that it would be a long while before they would be educated up to the high point that they could have all classes of iron and be able to use them in a scientific way. They have no disposition to cast any reflections upon the large concerns, which use, probably, but one grade of iron, or two. They appreciate how valuable this information is to those people, but

they are not able to take advantage of the position of these people who use one class or two classes of iron on a very large scale. (Applause).

The Secretary: Mr. President, the Committee would like to be discharged, as it says in the report. I am one of the members myself. We fully concur in what Mr. Bell has said. Those jobbing founders who are progressive are with us, and those jobbing founders who are not progressive are not with us, and so we cannot see that we can do any more than we have reported.

Mr. Best: Mr. President, I move that the committee be discharged with thanks. I think their duties have been very arduous and have been carried out effectively. Not only so, but there are great difficulties in the way of trying to get old style founders to take up the new methods of getting out work. There are different methods that could be adopted whereby the practice in foundries can be improved. Over in Canada, where I come from, there are a lot of small foundries. Almost every village has one. Go and tell them anything outside of the routine of what work has been done, and they will say, "Why, we have got the iron, and we do our work," and so on. I suppose you have foundries on this side of the line that are working somewhat on the same principle; that is to say, so long as they get an iron which will do the work. I move that the committee be discharged, with thanks.

(Motion seconded and adopted).

Mr. West: The next report is the progress report on Standard Methods for Determining the Constituents of Cast Iron.

PROGRESS REPORT ON STANDARD METHODS OF DETERMINING THE CONSTITUENTS OF CAST IRON.

The importance of adopting standard methods for determining the constituents of cast iron was fully recognized by this Association, when at the last convention it instructed the Standardizing Bureau to take up this work, and report thereon as soon as convenient. We beg to report that a large number of circular

and personal letters have been sent out to the professional men in our industry, requesting memoranda upon their methods, with a view of selecting standards therefrom.

These reports will be duly published in the "Journal," (omitting all names) in order that all the information may be properly grouped for critical study by the experts who will be asked to select the methods best adapted to our requirements.

In the meantime your committee solicits further communications from active iron chemists in order to have as wide an experience to draw from as possible. The amount of material received already indicates a wide-spread interest in this work, and it is to be hoped that a final report can soon be made.

Respectfully submitted,

Thos. D. West, Chairman,
Richard Moldenke,
James Scott,
P. W. Gates,
E. H. Putnam.

Report received and filed. The committee was continued.

Mr. West: I now have the last report.

PROGRESS REPORT
On The Foundry Trade School.

At the last convention the undersigned was appointed chairman of a committee to work in the interest of a FOUNDRY TRADE SCHOOL, wherein apprentices could be given the best practical and technical training for their trade, this training to fit them for the responsibilities even of master-mechanics and managers. The committee was recently enlarged by the appointment of Messrs. Putnam and Moldenke, but owing to the short time available since then, no opportunity has existed for any concerted action.

In the meantime, however, articles have appeared on the subject in the Trade Papers, and much criticism has been provoked partly favorable to the proposition, and partly unfavorable. Your committee believes that enough has been written during the year to warrant an expression of opinion on the part of the

members of our Association, as to whether the committee should be continued in the interest of this work.

It is the opinion of your committee that such an institution is badly needed, and that the day is not far distant when its importance will be disagreeably forced upon the trade. It will not do to sit by idly and be compelled to meet the issue. Far better to act at once. This is a movement, to be most successful, which should have the support of our foundrymen as well as the technical bodies interested in getting good castings.

Your committee asks for a full discussion of the matter in order to decide whether the work shall be conducted under the influence of our Association, or be left to outside effort.

Respectfully submitted,

Thos. D. West, Chairman,
E. H. Putnam,
Richard Moldenke.

Vice President Prince: Gentlemen, you hear the request of our Treasurer in regard to this school question. I think, as he does, that this is a question that should be discussed very thoroughly by the foundrymen of this country. I think there is no question, but that the foundrymen ought to have a school of some nature wherein the fundamental principles of the foundry business can be taught. As it has been in the past, we have all worked in the dark, and the old guard has done what they were taught from their apprenticehood. I think that instruction in foundry practice would help to elevate the business and be a benefit to us all. Gentlemen, you have heard the request of your Treasurer. What is your pleasure?

Mr. Slocum: Mr. Chairman, for a good many years I have, and I expect a good many of us have, been attending foundrymen's meetings monthly. Once in a great while we find something of interest; a great many times we don't. But in my experience with these meetings, the thing which has interested me the most has been a series of papers which have been read and discussed before the Pittsburg Foundrymen's Association on this same subject. We have had one or two very able papers and discussions on those papers— papers read by Mr. Kreutzpointner of Altoona, who is very well informed, has evidently made a life study of it. I think he opened my eyes, as

well as those of a great many others, as to the things which we did not appreciate and did not understand. We went to work there and received the co-operation of the superintendents of manual training schools of Pittsburg. They came and talked to us one evening at our meeting, bringing models, giving views, showing the entire process, and it was intensely interesting. It was practicable. It showed us what might be done. In the curriculum of these schools, one phase, the larger phase, is teaching the students to appreciate and understand the metals and materials which they may handle in after life, especially those occurring in the neighborhood in which they are being taught. Consequently in Pittsburg the instruction turns largely on iron and steel and the things which are used in conjunction with these two items. In some of the schools they have gone to the extent of drilling the boys in the work of most of the departments necessary in a well regulated foundry. They take up the carpenter work, the pattern work, moulding, and the actual use of a cupola. Some of the work which is turned out by these young lads, would put to shame a good many men that are employed in our pattern shops. As a matter of fact, they go even farther than that. Some of the small models which they exhibited of course were largely fancy work, but the skill and the understanding necessary to produce them showed an understanding which surpasses some moulders I have in my shop. Still those moulders have been taught a trick and can earn their money. I should be very much disappointed if this committee was discontinued. I think if it was taken up on the same lines on which we are endeavoring to take up the matter in Pittsburg, and carried forward, it would be a very large help to all of us, and I think most of the foundrymen would stand in a position where they would be very glad to take the graduates of these schools. I know that my concern, for one, would be very glad to get them. Schools of this kind would turn out young fellows who are bright. They would not take the course unless they were ambitious. All they need afterwards is a little strength, and getting into a foundry soon does this for them. They generally come out a little tougher than they go in—not only physically, but sometimes otherwise. I would suggest that this committee be continued on the same lines on which they have been working.

Mr. West: Mr. President, may I add a word? I just want to catch a valuable point Mr. Slocum makes there, so as to continue the discussion. He refers to the benefit of our present technical schools in teaching the art of foundry. He admits that they are very beneficial. Now, I wish to make the statement, that at present all the time, for instance in Cornell University (which has a very excellent foundry, about the best I know of in the country), for teaching its students foundry work, is fifteen days, if I am right, altogether. If we will take into consideration that he admits that that fifteen days is so beneficial, what must we expect if we will have three and a half to four years of continued effort in that direction.

Mr. Slocum: Mr. West misunderstood me. I was not referring to Cornell; I was referring to our daily schools in Pittsburg and Allegheny. I have had a little experience with the graduates of Cornell. I had a young man come to me when I was in Buffalo a few years ago who had gone through a course, and he was sent to me very highly recommended. He was not only a practical moulder, but he had the technicality; in fact, he had everything, a great many things which I did not have. The result was, after he had been with me two or three weeks, I gave him a position in the office.

Vice President Prince: I think the schools are perfectly proper. I think that the American Foundrymen's Association should take up this question. We have a fitting illustration right here in our acting president now. I am certainly not in a position to talk as intelligently to the foundrymen, as I should do. When it goes into the old fashioned work I could do it. I think foundrymen should all be in a better position both to talk and act and to instruct each other. This would be acquired by students going to a school and learning the business and being able to explain it. There are ideas which are coming out every day that should be put into shape and given to the foundry trade at large, and foundrymen as a body should be able to get up and talk intelligently.

Mr. Best: Mr. President, is it the intention of the association to form a central school, and from that to send literature throughout the land in order to form separate schools, or branches, whereby boys could be taught simultaneously from the cen-

tral school; or is it to establish a school in each locality working within its own sphere? It seems to me, if there could be a central school, with proper methods laid out from there, and literature sent out, whereby the boys could be taught, that good results might ensue. Mr. Slocum has made reference to the public schools. I have seen things produced by very small boys, boys of eight and ten years of age, which have been astonishing to me. After taking three or four lessons at what they term one of their "sloyds"—they call it sloyd over there—little boys will produce things in wood that to me have been wonderful. I don't see how the knowledge could be put into them, but it has been done. I have seen cases where pattern makers two or three years working at the trade could not do better than has been done after a few lessons by the boys. The teachers must have had great ability and great tact, to infuse such ideas into the children. If, as I said before, a central school could be established, and the information pass out, I think it would be of great good.

Mr. West: Mr. President, may I just offer an explanation? Mr. Best inquires what would be the nature of this school in regard to its distribution of work. At the present time ideas are but vague. The intention is to get started with a regular, practical, every day work shop, either connected with some technical institution, or in a locality where technical instructors could be had for the evening. Three or four evenings every week would be given up to the study of the principles of the trade and also to a study of whatever intricate work would be involved. All such information would be brought to the notice of the students, and discussions would be carried on along proper lines. Then, also, in matters of management. There is not one of us who is a manager to-day in a foundry but knows that when he became a foreman he was simply asked to be a foreman, there were no instructions given to him, and he was watched to see if he had the necessary tact. Nobody told him what that meant; he simply had to go in and use his wits the best he could. There is a great deal of information that I think can be outlined from experience and put into such shape that we can make for better managers than we have to-day. We can give the young men some confidence in themselves. We can lay down proper rules

and principles and give them a good general idea of business. As a rule, a man who is merely a foreman, with no money invested in the business, has a very visionary outlook. If we could knock that out of him and get him down to strict business, to realize, if possible, what it would be if he had his own dollars and cents invested, then he would have a different view of the matter as a manager. I believe a school of this character could bring returns from such a form of education. As to what might come after a school was started, why, that is an open question. But I don't look upon it as so necessary that this school be large. I think that if there were simply one school no matter where, with the influence that would come from it, there isn't a manager here who would not watch it, know what it was doing, know what its methods were, and an influence would go out from that school to his work shop. If there were only a dozen apprentices created by this school, I believe that it would be very beneficial the country over.

Mr. Seaman: Mr. President, I believe we had this discussion up last year at Buffalo and there was quite a talk about the matter at that time. The question was brought up of what was being done for a school of this class. I then made a report that we were in a fair way to have a school of this kind in Pittsburg, and a good school at that. The school should have been really—well, partly constructed by this time, but we in Pittsburg are like most all other cities, we have got a little too much politics there. The politics has interfered somewhat with the purchase of the ground for the institute. They are now about closing for the purchase of the ground. The city of Pittsburg will pay half a million dollars for 62 acres. Andrew Carnegie has donated $7,000,000 to establish this institute, and I will say that one of the principal features of the institute is going to be the foundry end of it. I will say that the Chairman of the committee that has the arrangement and the designating of what the institute shall be is a foundryman. Another member of that committee is a foundryman. The Pittsburg Foundrymen's Association has appointed a committee to keep the directors and managers of the Carnegie Institute well stirred up in regard to the foundry business, which they are doing, and I think that we will have in Pittsburg an institute where any young man or eld-

erly man that wants to get any information about the foundry business can get it, whether it be a course of six months or six years. We will have it all there. If our association undertakes to build an institution of that kind I don't think we will be able to raise the means to do it, in the first place, and it will require a large endowment. It is not simply a question of putting a young man on a foundry floor and shovelling up a certain amount of sand, or, in other words, as some express it, digging a hole in the ground and pouring iron in it. There is something back of that required. There is some knowledge required, some education required, in order to know why these things are done. This is the object of the foundry part of the Carnegie Institute. And it will be open for everybody. I really think it would be a waste of time on the part of the American Foundrymen's Association to take up this matter, unless they go in jointly with this institution and help to get things there up properly, as they possibly may overlook many things in organizing. I will say this, that the management of this institution is willing to receive any suggestions that would be to the interest of the foundrymen or the education of the foundrymen in the United States. I merely mention this matter so that the facts of the case may be understood, and also to let the association know what is being done toward the education of the foundrymen.

Mr. West: Mr. President, I beg for another word here. I am glad that Mr. Seaman has brought this subject up, because it permits me to make an explanation that I could not very well make in the report. I made a special trip to see Mr. McConway, the chairman of this Carnegie Technical School, to learn, if possible, what were their intentions, and whether or not it was to be an institution which would fill the need of advanced foundrymen of to-day. I had quite a long talk with Mr. McConway and it seemed to show me that the institution was not intended to fill what is being advocated on the floor here to-day. They mean merely to follow in the present line of colleges. I explained very explicitly to Mr. McConway what was needed, and he felt sorry that the thing could not be carried in that line, but as far as it was to go would be in the present day lines. I think that, if Mr. Seaman would have a conversation with Mr. McConway, he would learn of my visit to him and the result. It is

my opinion that any millionaire who wants to benefit the race to-day can do great good by donating a few hundred thousand, or, if he wants, a million dollars, to the object of establishing a strictly practical school, a practical every day foundry school, not where you have got fifteen days through four years, but where you have got every day for four years, eight or nine hours actual work and then your technical training outside. Give us a school like that, and the man that donates the money to support such a thing I think will build a monument to himself bigger than any that is done yet at the present day.

Mr. Slocum: Mr. President, I don't want to occupy too much of the time. I have had no personal conversation with Mr. McConway, but I have with other members of the committee. While no details have been gone over, the impression has been conveyed to me very forcibly that the idea of the donation was simply to do the most possible good, and ideas that have been brought up so far which were practical and could be utilized, they were going to adopt. If Mr. McConway has any such idea in his head at the present time as is suggested, I would like to make the motion that this association appoint a committee to work in conjunction with the committee of the Pittsburg Foundrymen's Association to clear his head of those ideas.

Mr. Seaman: Mr. President, before the motion is put I just want to make a word of explanation in reply to Mr. West's remarks. The Board of Managers of the Carnegie Institute have not adopted any line of work, any more than that a full foundry equipment will be built and foundry methods taught, not only for light castings but heavy castings. They are going to build a large institution there. The idea is to educate young men who are taken from the public schools, to take them in there and give them all the branches of education that they require, and practical knowledge, so far as possible, not only in the foundry business, but in the machine business and in other kindred lines. The main object is to educate those young men in a mechanical line, to make them thorough mechanics, so that they can leave that school and into any workshop. We have our colleges, that is all true, institutes of different kinds; but Mr. Carnegie is reaching out for something far beyond this, just the same as he is in what he is establishing in Washington. We

all know what he is doing there. This technical institute is intended to be an advance beyond anything we have now. He wants to make it practical, carrying out the old theory that he does not want to donate anything to a lazy man, he wants a man to work and earn his own living, he is willing to put him in a position to earn his own living. His charity runs in that line. As we all know, he won't give anything outright to charity, but he gives it in that way, which is the best of charity.

Mr. West: Mr. President, another word, please. I would like to state here that we have got to bear in mind, in order to secure the greatest benefit from our school, that it is simply a business proposition. We have got to open up a shop, and we have got to obtain work. Nobody will come there and give work for the love of giving it and take anything he can get; he will come there the same as he would go to any other place. Quality and price is going to bring the work. Now, I emphasize again that in my conversation with Mr. McConway he could not assure me that Mr. Carnegie's ideas were along mine whatsoever or that he would take that matter up. I urged the importance of the work very strongly. He may have changed his views since then. They may be taking action along practical lines, but if they do they have got to have a regular shop, and they have got to secure work from the outside the best they can, sufficient to keep probably from 50 to 100 men, or students, going. I only hope that it is true, as Mr. Seaman says, that they are working along practical lines.

The Secretary: It has been moved and seconded that a committee be appointed from this association to co-operate with the Pittsburg Foundrymen's Association in the direction of the Carnegie foundation. I think it ought to be amended to carry the discharge of the present committee.

Mr. Slocum: I accept the amendment. My idea of having a committee of this association working with the other was simply to make it more marked that there is a demand for a school of that kind.

Mr. McPhee: Mr. President, we don't seem to thoroughly understand the matter. Is there to be a foundry attached to this school? There seems to be a kind of misunderstanding in the matter. I should like to say right here at this time that this

is the proper place for us to go to work and listen to the ideas of the foundrymen on these lines. If Mr. Carnegie is going to work to establish a foundry to educate student in the foundry business we ought to have some explanation, so that this committee might be instructed to wait on the men in Pittsburg that are going to have this foundry, if there is going to be a foundry. If there is not, why, it seems to me that there is a splendid field right straight here in the Foundrymen's Association of the United States to go to work and take this up and establish a foundry school. We know to-day that the foundry is away behind other trades; we know that it is, and something that we ought to have is instruction given to the moulder. While of course the pattern maker to-day is considered far ahead of the moulder, I tell you I think it is the place for him to go right straight into the foundry. The moulder makes mistakes. The pattern maker makes mistakes; but it is not considered a mistake in the pattern maker, it is only an oversight. A great many times, when I have seen the patterns brought into the shop and worked on, I have thought that the pattern maker ought to put in about two years in the foundry in order to get at his drafts.

Mr. Bell: Mr. Chairman: Mr. Seaman is probably the best informed man in regard to the Carnegie Institute that there is on this floor or anywhere else outside of the trustees themselves. He is in constant communication with them, and he knows as nearly as anybody knows their purpose. They have not decided upon the line of what they are going to build or what they are going to do, but they are investigating, and their intention, so fars as expressed or known now, is to organize such a school as Mr. West and these other gentlemen are advocating, and, having the best means, when they undertake to do it, they will undoubtedly undertake to do it well. Mr. Seaman is also of the committee of the Pittsburgh Foundrymen's Association to keep in touch with the trustees of the Carnegie Institute, so that he, as he has informed us, is advised of the advanced position that those trustees occupy. We, as an association, as the American Foundrymen's Association, can appoint a committee to co-operate with him and his committee, giving it more strength, giving more force behind it to carry out what

it is already doing in Pittsburgh, urging the trustees of the Carnegie Institute to establish just the very thing that has been advocated here. I believe that is the idea.

Mr. Slocum: That is the idea of my motion.

(Motion adopted).

The Secretary: Mr. President: I think the next thing on the programme is the presentation of the Standard Specifications for Steel Castings. The American Society for Testing Materials have devised specifications for testing steel castings, and, as we are members, I have had them printed, and they are distributed here, as discussion is welcomed. They have been adopted now and are generally used.

STANDARD SPECIFICATIONS FOR STEEL CASTINGS

As adopted by the American Association for testing Materials, of which the American Foundrymen's Association is a member. These specifications are presented before our Convention with a view of eliciting further discussion on the subject.

PROCESS OF MANUFACTURE.

1. Steel for castings may be made by the open-hearth, crucible or Bessemer process. Castings to be annealed or unannealed as specified.

CHEMICAL PROPERTIES.

2. Ordinary castings, those in which no physical requirements are specified, shall not contain over 0.40 per cent. of carbon, nor over 0.08 per cent. of phosphorus.

3. Castings which are subjected to physical test shall not contain over 0.05 per cent. of phosphorus, nor over 0.05 per cent. of sulphur.

PHYSICAL PROPERTIES.

4. Tested castings shall be of three classes: "Hard," "Me-

dium," and "Soft." The minimum physical qualities required in each class shall be as follows:

	Hard castings.	Medium castings.	Soft castings.
Tensile strength, pounds per square inch	85,000	70,000	60,000
Yield point, pounds per square inch....	38,250	31,500	27,000
Elongation, per cent. in two inches....	15	18	22
Contraction of area, per cent.....	20	25	30

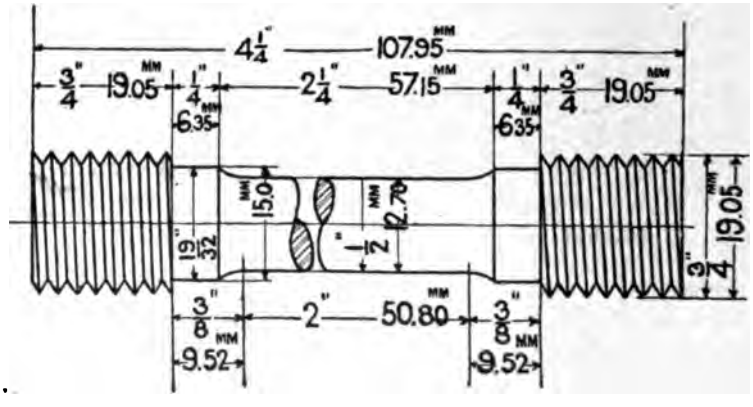
5. A test to destruction may be substituted for the tensile test, in the case of small or unimportant castings, by selecting three castings from a lot. This test shall show the material to be ductile and free from injurious defects, and suitable for the purposes intended. A lot shall consist of all castings from the same melt or blow, annealed in the same furnace charge.

6. Large castings are to be suspended and hammered all over. No cracks, flaws, defects, nor weakness shall appear after such treatment.

7. A specimen one inch by one-half inch (1" x 1-2") shall bend cold around a diameter of one inch (1") without fracture on outside of bent portion, through an angle of 120 degrees for "soft" castings, and 90 degrees for "medium" castings.

TEST PIECES AND METHODS OF TESTING.

8. The standard turned test specimen, one-half inch (1-2") diameter and two inch (2") gauged length, shall be used to determine the physical properties specified in paragraph No. 4. It is shown in the following sketch:



9. The number of standard test specimens shall depend upon the character and importance of the castings. A test piece shall be cut cold from a coupon to be molded and cast on some portion of one or more castings from each melt or blow or from the sink-heads (in case heads of sufficient size are used). The coupon or sink-head must receive the same treatment as the casting or castings, before the specimen is cut out, and before the coupon or sink-head is removed from the casting.

10. One specimen for bending test one inch by one-half inch (1" x 1-2") shall be cut cold from the coupon or sink-head of the casting or castings as specified in paragraph No. 9. The bending test may be made by pressure, or by blows.

11. The yield point specified in paragraph No. 4 shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine.

12. Turnings from the tensile specimen, drillings from the bending specimen, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in phosphorus and sulphur specified in paragraphs Nos. 2 and 3.

FINISH.

13. Castings shall be true to pattern, free from blemishes, flaws or shrinkage cracks. Bearing surfaces shall be solid, and no porosity shall be allowed in positions where the resistance and value of the casting for the purpose intended, will be seriously affected thereby.

INSPECTION.

14. The inspector representing the purchaser, shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

Mr. President: The next thing will be the presentation of the Method of Insuring Patterns, by Mr. Conlin, who is here and is ready to address us on the subject.

MEMORIAL ON THE INSURING OF PATTERNS.

The favorable comment and general interest taken in a paper entitled, "Insuring Patterns," read at the last annual convention of the American Foundrymen's Association at Buffalo, 1901, warrants further discussion on the subject with the view of reaching some tangible results therefrom.

The question of the insuring of patterns has not received the attention due its importance, and there is an urgent need for the adoption of some standard method of adjusting fire losses and establishing trade regulations regarding customers' patterns

Accordingly this memorial is respectfully offered for consideration in due appreciation of the great value of concerted action and official recognition from so representative a body as the American Foundrymen's Association

It is urged that a committee be appointed to study the question of the insuring of patterns, to obtain the views of both Foundrymen and Fire Underwriters, formulate a code and publish it in the American Foundrymen's Journal, and request criticisms as well as an exchange of ideas on the subject. The result of such deliberations to be incorporated in a final report with recommendations for adoption at the next convention of this Association.

The high rate of premiums charged, and in fact the general unwillingness of insurance companies to assume full fire risks on patterns, is owing largely to the difficulty experienced in arriving at a true appraisal of values. This is mainly due to the general absence of complete records of patterns embodying systematic classifications as to service value. It is also a fact that the insurance companies have no clearly-defined working basis as to depreciation deductions, etc.

This lack of system can be remedied by bringing the foundry and the insurance interests together. It is practicable to have adopted and brought into general use a "Pattern Clause" to be attached to the insurance policy, making the contract as to pattern risk, subject to the rules jointly adopted by the Board of Underwriters and the American Foundrymen's Association.

It is also equally feasible to adopt rules and regulations governing important questions concerning pattern insurance,

which would avoid many troublesome tangles as to the adjustment of fire losses, all to the mutual relief of both assured and insurer.

It is an easy matter to arrive at the cost value of a pattern, but the deductions for depreciation is the bone of contention. The service value is the true value of a special tool like a pattern. It is limited to the cost of reproduction.

To arrive at a true basis for the appraisal of pattern values it is necessary to consider:

First.—A method of classification, under specific headings, such as

Active or Current.
Active, Worn.
Semi-active.
Repair for Emergency.
Obsolete.

Second.—A fixed allowance for depreciation deductions to be made either annually or semi-annually, and according to changes as to service value as defined by the above classification.

The adoption and use of a general form of book or card system record, including classification and valuation, would remedy the present erratic and unreliable methods of determining fire losses. In the same way pattern risks would be more readily accepted and possibly at lower rates by eliminating the hazard caused by general lack of record to substantiate claims as to loss of patterns and their service value.

It is entirely within the scope of this Association, which is and should be the Foundrymen's National Board of Trade, to establish rules and regulations similar in effect and general usefulness to those adopted by the New York Produce Exchange and other trade organizations. By this means trade customs would be legally construed and the adopted rules regulating the insuring of patterns would become the law and usage of the foundry trade.

Various important questions which are to-day open to much discussion and doubt, could be effectually disposed of. The responsibility of the foundryman to his customer for pat-

terns lost or damaged, owing to fire casualty, is a subject not generally understood, and for the mutual benefit of both parties, their respective positions should be clearly defined. For instance, the ordinary form of policy insuring the foundryman's patterns does not include the property of others. A policy containing the clause covering "the patterns held by the assured, the property of others for which the assured may be responsible," requires evidence to show that the foundryman entered into a specific agreement to be responsible for the customer's patterns. Otherwise the question of responsibility is one to be left to a jury, and according to the common law as to bailments, the foundryman, whether compensated or not, is only responsible when it can be proven that he did not exercise ordinary care in the preservation and protection of the property destroyed, and the term "ordinary care" is held by the court to mean that degree of care which an ordinarily prudent man usually exercises in the preservation and protection of his own property. (See Parson on Contracts and Scouler on Bailments).

The conditions surrounding a customer's patterns are different from those owned by the foundryman, in as much as they should always be considered as active and of value equal to the cost of replacing. They are held by and subject to the control of others, and should be covered by a floating policy insuring the patterns wherever they may be. For these reasons, the question of insurance in regard to customer's patterns requires attention as to the best form of policy available, so as to enable the customer to secure the most effective protection against loss by fire casualty.

The transfer of patterns via railroad or other common carriers is clearly defined by law in a general way. The compensation paid for the transportation includes also the guarantee to deliver the goods in same condition as received, and the common carrier accordingly is supposed to insure the shipment, while he is responsible for it. It would be advantageous to clearly define where this responsibility begins and where it ends.

Under the province of trade usage or custom, it is advisable to define if the term "pattern" includes as well, core boxes, follow boards, matches, etc., or any special rig which may be used in connection with a pattern for use in moulding from same, of course not including flasks.

It is also desirable to define the trade meaning of the terms used for classification of patterns, so as to identify their condition, value, and prospective service as active, repair, obsolete, etc.

The storage of patterns involves the question as to natural hazard. The consideration of the most desirable location and arrangement of structures for the care and protection of patterns is important in many ways, one of which is to lessen the element of fire risk which would tend to reduce both restrictions and rates of premiums as to patterns.

The advisability of insuring patterns under a blanket policy covering them wherever they may be within given boundaries, or of fixing a specified amount of insurance on the item of patterns of each building in which it is the practice to store or use them, is also a question worthy of attention.

It is hoped that the value and importance of bringing the subject of pattern insurance into more systematic shape, will be recognized by the adoption of a code of rules regulating and defining the various questions involved, and by this means a lasting service rendered.

It is, therefore, urged that it be

Resolved, That a committee of three be appointed to formulate rules and recommendations concerning the insurance of patterns to be submitted for adoption at the next convention of the American Foundrymen's Association. That such committee be authorized to confer with the proper insurance officials with the view of securing their co-operation in the consideration and adjustment of the various questions relating to the insurance of patterns.

Respectfully submitted,

F. CONLIN.

The motion of Mr. Conlin was seconded and carried. Mr. Carpenter then made some announcements with reference to the ball games and civic parade scheduled for the afternoon, and Mr. Brown then took the floor to detail the historical trip.

Mr. Brown: That historical trip is simply a trip in the old, congested part of Boston, taking in the old residences and old

locations of the events of the Revolution and before that time. There can be no conveyance; it is simply a walk, which will take some little time, perhaps two hours and a half. It is a very short walk, however, the lecture of Mr. Waterman, the guide, taking the time in explanation as we go along. During the walk there will be one or two stops. One will be at the King's Chapel, the church that was here before the Revolutionary times. We are to be admitted there by special arrangement, and will have a resting spell. A little later we come to the old John Hancock Tavern, where the Tea Party originated, and where the citizens dressed as Indians to make their attack and throw the tea overboard. There we are to have a little tea served! So that it is really wholly an historical trip, and those that would enjoy any such thing we should be very glad to have with us. It was arranged particularly for the ladies, but all gentlemen will be very welcome.

Vice-President Prince: Dr. Moldenke will now present a memorial on the proper valuation of pig iron in the foundry.

MEMORIAL

On The Proper Valuation Of Pig Iron For Foundry Purposes.

The undersigned respectfully begs to memorialize the American Foundrymen's Association on behalf of a better method of valuing pig iron for foundry purposes than is at present in vogue.

As far back as our memories will carry us, there have been made pig irons of good, indifferent, and poor value, for the making of castings, and with few exceptions they have been sold on practically the same terms. In view of the fact that at the present time every effort is bent upon securing better material for our castings in order to hold the field cast iron is entitled to, it behooves us to devise some standard methods by which a poor iron may either be culled out, or else sold for its intrinsic value only. On the other hand, the maker of pig irons which have suffered least from careless burdening, improper mixing of ores with waste products, and other practices better known to the furnaceman, but not tending to good strength in the resulting pig, should be rewarded therefor accordingly.

It is a well known circumstance to all founders that pig irons of the same shape, grade, and presumably the same composition, but coming from different furnaces, when remelted under as nearly the same conditions as possible, will often show entirely different strengths. Those who have laboratories will know that this is even the case when the composition is approximately identical. For this reason it is somewhat of guess work to predict the strength of a casting from the composition of the irons used, and an element of doubt remains even with the best of mixing and manipulation.

Now that the Standardizing Bureau of our Association has made such a splendid record in the course of bettering methods of foundry procedure, why not let it go one step further, and instruct it to devise methods by which we can better judge the value of the pig irons offered us.

As a starting point the following is suggested: The value to us of a pig iron is seen only in its remelted state, therefore to test it we must put it through cupola or furnace, and under conditions which will give it the fairest chance possible. Furthermore the iron should be cast into test bars according to the standards provided for by this Association. An analysis of the pig iron and the test bars as well as the physical tests of the latter, can then be made, and we will know that a given iron when remelted and tested has such and such a strength for such and such a composition. We may then choose for our work, condemning the weak irons and selecting those which show promise of fulfilling the conditions required.

Since the furnaceman should have the means of valuing the iron he sells just as much as the foundryman who does the buying, it would be advisable that specifications be drawn up for a standard test cupola, standard methods of melting, pouring, etc., of a stated amount of pig iron. A suitable blank shall be drawn up in which can be filled all the information necessary to properly value the iron.

Furthermore, it is suggested, that besides furnishing these standard methods to the trade for the individual use of any one who desires to obtain the information, facilities be given the Standardizing Bureau to take this matter in hand themselves for the benefit of those who do not care to go to the trouble of

carrying out the process on the exact lines indicated. The bureau will then be in position to actually make the bars for test and prepare the samples for analysis. The bars can then be sent for test and the samples for analytical work to the laboratory specified, or in the absence of instructions, be turned over to an approved laboratory. A moderate charge should be made to cover the work done, and to make the undertaking self-sustaining.

Should the plan here outlined prove feasible, the furnaceman who has good iron will find it a much easier matter to induce the prospective purchaser to try it. The foundryman, on the other hand, can buy the iron subject to the standard test, the results he wants of which he can demand guaranteed.

Gradually there will be a series of tests available which will serve to indicate the physical properties of a good iron of a given composition, when remelted, and we will hear less of inferior irons worrying the founder who has to furnish high grade castings. The undersigned would therefore offer the following:

Resolved, That the Committee on the Standardizing Bureau be requested to study the proper valuation of pig irons for foundry use, and, if possible, report standard methods therefor at the next convention.

Respectfully submitted,

Richard Moldenke.

Resolution seconded and carried.

The convention now adjourns to meet on Wednesday, the 18th, at 10 P. M.

The afternoon was devoted to various forms of entertainment. The day being the anniversary of the battle of Bunker Hill, a great military and civic parade was the principal feature. Our members were guests of the city, special grand stands being provided to accommodate them. Incidentally this shows how highly the industry is regarded by the good city of Boston, as it involved considerable trouble and expense on the part of its representatives, as well as "magnetism" on the part of the committee.

Again, those of the visitors who were addicted to the "Diamond" were given a treat in witnessing the game between the New York and Boston teams of the National League. Perfect weather promoted the happiness of everybody, and spoiled the chances for another business session that afternoon.

The third contingent were taken about the old city to study the points of historic interest, and this proved a most acceptable form of entertainment, as it brought us close to our early history. Few were they who saw the spot where the first patriot fell, who did not for an instant feel the inspiration of awe, as the thought of what came of this event flashed across the mind. Visions of our brave boys fighting in the Philippines were mingled with the more distant jets of fire from the flint-locks with blue and buff forms behind them, and brave red-coats rushing to their doom. The ground of old Boston seemed more hallowed after this, and our thoughts will ever stray back to a city of perfect repose, of culture that we long to see everywhere in our great land, and that warmth of friendliness which should make life there most worth living.

In the evening the convention gathered in the Tremont Theatre, which our hosts had practically reserved as a whole. An interesting comic opera was given; nor were there lacking telling hits on many of our more prominent members. All went home feeling that the day had contained about the maximum of events it could well carry, and many friendships were again cemented, new connections made, and solid thought and comment interchanged.

WEDNESDAY, JUNE 13th, 1902.

Through the courtesy of the Institute of Technology authority, parties of the members of our Association were conducted through the engineering laboratories, where the testing of materials was carried out. Prof. Lanza and the able adjunct professors of the department explained the various steam, hydraulic and compressed air systems very thoroughly. Illustrated methods of making boiler tests, engine and electrical tests, tests of wooden and steel beams, and methods of testing castings and cast iron. Thus an hour was consumed which proved most profitable.

At 10 A. M. Vice-President Prince called the convention to order for the second business session. The place of meeting was again in Huntington Hall, of the Massachusetts Institute of Technology.

Vice-President Prince then made the following announcements:

Nominating Committee.—Messrs. Yagle, Colvin, Golden, Wolff and Flagg.

Auditing Committee.—Messrs. Seaman, Yagle and Brown.

Committee on Trade School.—Messrs. Seaman, Yagle, Zimmers and West.

Committee on Insuring Patterns.—To consist of Mr. Conlin as Chairman, with power to appoint two other members.

Vice-President Prince: I will now call upon Mr. Reid to read the first paper on the programme of this session.

Mr. Reid: Mr. President and Gentlemen: Dr. Moldenke and I had a little correspondence in regard to this paper, and, as you will notice later on, it is just simply the principle that is stated. There has been considerable criticism on the working of the plan presented in actual practice, but I can state distinctly that we have made it a success. A number of the foundrymen present to-day have been kind enough to say that it might do well enough way up in the wilds of Maine, but it cannot be done well here, and I think this will be a good opportunity for them to state their opinions, because we are here to get up discussions in regard to the various methods for increasing the foundry production.

Mr. Reid now read his paper, and then followed a

Discussion on SOME METHODS OF INCREASING FOUNDRY PRODUCTION.

Vice-President Prince: You have heard the reading of the paper, and it is open to discussion. I think Mr. Reid would be glad to answer any questions, because that idea of running double crews, night and day, is always a bug-a-boo to the founder.

Mr. Flagg: I would like to ask Mr. Reid a few questions. One is: Has he ever run this shop during hot weather, and, if so, how does he manage the crew of men with the pouring? How many hours do they continue at pouring? Another question is: Do the molders work piece work, and, if so, how does he adjust matters of loss, which a molder would claim was caused by the pourer, and was not his own fault. The third question is: Does he run a union shop with his molders? The fourth question is: Do they work in benches? I ask that question because I have run a shop double time, and we always had trouble with the hot sand and cold sand. Our benches were very narrow. With a wide bench I think it would be much easier to do it. If you will kindly answer those questions I will be obliged.

Mr. Reid: If I may take them in rotation I will do so. We have succeeded in running it in warm weather with the addition of extra men so that we have crew enough. I double my crew so that the men take one night off and one night on in pouring. The entire time of pouring depends a great deal on the amount melted, and that varies from three and one-half to five hours every day. The molders work day work. I make the statement now that in my opinion the work is better, we turn out more work for the same number of hands day work by this system, and get better results all around than we would on a piece work system. The third question: We do run a union shop. Some three years ago the men went out on strike. Every man was a member of the union, even the apprentices. But I took hold there and we made an agreement. They had asked for a very large minimum, and we rejected that. They had a set day's

work; I would not recognize anything of the sort. What I recognize as a day's work is what a man can do from the time he starts in the morning until he quits at night; that is the day's work, and we pay for it accordingly. You may call it a union shop, inasmuch as we have an agreement that we will pay not less than $2.25 a day, that is all. There are three men getting $2.25; the rest get over. The benches: I suppose you mean by that the floor space. The floor space averages nine feet wide by eighteen feet deep.

Vice-President Prince: Any more questions to be asked on this paper?

The Secretary: Mr. President: The chances are that this subject, which is an exceedingly important one, had better be left in such a way that if our members do not wish to cover it now they may write little discussions of it and send it to me, and I will be very glad to publish it, because working in the way Mr. Reid has spoken of may be one of the important coming things. That we are not talking of it much here is no criterion that we are not very much interested in it.

Mr. Trabue: Mr. Chairman: I did not hear Mr. Reid answer that question referring to the adjustment of losses occasioned to the molder by the pourers.

Vice-President Prince: His was day work, not piece work, and there would not be any losses to the molder.

Mr. Field: Does he find any trouble by the molders putting it on to the pourers, and the pourers laying it on to the molders? Even though it is not piece work there might be more or less friction caused that way.

Vice-President Prince: I think that being a day work shop there would not be so much friction between the molder and the pourer. If it was piece work I think Mr. Reid would find out that he would have considerable friction between the pourer and the molder, because when a molder is working piece work, he must stand his own loss, and naturally does not want any person else to pour his work for him. He will invariably blame it, if it is bad, on the pourer. That is the rule. Have you anything to say on this, Mr. Reid?

Mr. Reid: Well, only to add this, that if you will take molders as you find them, I am afraid that ninety-nine per cent. will kick anyway.

Vice-President Prince: The next paper on the programme is on Shop Conditions, by Mr. Hugh McPhee.

Mr. McPhee: Mr. President and Gentlemen: We understand how the foundry business at the present time is run, because, being all foundrymen, we pretty nearly understand each other. I must say at this time that while the foundry is becoming improved, still there is a large room yet in this direction.

Mr. McPhee now read his paper on "Shop Conditions."

Vice-President Prince: You have heard the reading of the paper. It is somewhat in the same line that Mr. Reid speaks about, shaking out and taking out the castings for the molder. It looks as though they are going to give the molder a better chance, from now on, anyhow. The paper is now open for discussion.

Discussion on SHOP CONDITIONS.

Mr. Reid: Mr. Chairman: Mr. McPhee reports here that he could put in eight hours molding instead of six. I am pleased to say that we get nine and one-half molding.

Vice-President Prince: Well, Mr. Reid, your conditions are different.

Mr. Reid: Certainly. It is all in the same direction, but Mr. McPhee could put it a little stronger.

Mr. Lanigan: I would like to ask Mr. Reid if he regulates the wages of the men in his shop by the number of flasks that they make. He tells us he pays $2.25 upwards. Now, are we to understand that that is the minimum rate of wages in his shop, $2.25?

Mr. Reid: $2.25 is the minimum rate. We do not recognize any special amount, though in certain lines of work, where it is the same thing day in and day out, we have a pretty well defined limit to the ability of the man and regulate the price accordingly. If he does not come up to our standard he does not get the money. There are three men getting $2.25, and the rest are graded according to their ability, that is the amount of work they put out. Does that answer Mr. Lanigan?

Mr. Yagle: We want to know how many founderies are in the town this gentleman comes from.

Mr. Reid: Mr. Chairman and Gentlemen: The gentleman asks the question how many foundries there are in the town —I beg pardon, it is a city (laughter)—in the city where I come from. There were three; there are two to-day.

Vice-President Prince: The reason that I brought up the question about Mr. Reid's conditions, or rather his time, was that in Pittsburgh nine hours is considered a day's work, and if you work three minutes over nine hours it is deducted from you the next day, or on Saturday, as they more generally keep the time. In some shops, nine hours being a day, if you work nine hours and ten minutes on Thursday and the same on Friday, you get off those twenty minutes earlier on Saturday. Whatever time you work over they deduct on Saturday, and the molders are supposed to get out. This is in some shops. Your shop appears to be a nine hour and a half or ten hour shop.

Mr. Reid: Mr. Chairman, in regard to that, I cover that, I think, in my paper, where I state according to the number of hours we are supposed to work. Now, I recognize the fact that in some districts they are struggling for eight hours a day, in some they have already nine. Our district is ten hours. I give them half an hour.

Mr. Lanigan: Mr. Chairman: I would like to ask Mr. Reid if he got an increased number of flasks on his standard day's work when he commenced to have the laborers do the pouring?

Mr. Reid: It certainly would not pay any other way. Our actual gain in molding time was two hundred and fifty hours a day.

And in that the work, of course, varies. On the bench we gain from ten to twenty flasks; on the floor, according to the work, from one flask to three.

Mr. Murphy: The worst of it all seems to be that we don't know the number of flasks put up in a foundry. I am rather familiar with the conditions in the eastern part of the country, and the conditions that can be employed in the shops around the eastern part of New England, and the method of running those shops are not entirely applicable to shops in the western part of the country that handle a larger and heavier and better class of

work. I remember one time I travelled down through the eastern part of Maine, and it took a mighty good molder, one that could do a great big day's work, to get $1.50 a day. That is what a man paid me down there one time. They cast in the forenoon and in the afternoon, or twice a day. I asked him what he was going to pay, and he told me if I was a pretty good man he would give me $1.50 a day. Of course I understand the conditions have been a little bit better up in this part of the country since that time, but nevertheless, the conditions that are applicable to shops in Maine, Vermont and New Hampshire, and part of Canada, would not be applicable to shops in other parts of the country. As a matter of fact there is not the class of mechanics in this part of the country that may be found in others. Down in that part of the country men are paid more for what they do, instead of for what they know. In the shops that are running all the time, they know what a man can do every day, and if he has got an extra hour to do any molding in they know just how many flasks he can put in. The system is a very good one, it is a modern one, and should be applied to any shop that can manage it. I have nothing whatever to say against the system, anything more than it is useless to discuss such things in any lengthy manner, because what is applicable to one shop is not applicable to another.

Mr. Pero. I want to take exception to one remark of the last gentleman, and that is that the class of mechanics in this part of the country are not as good as they are in other parts. I am a New England man. I have travelled over a good fair section of this country, as far west as the Mississippi, and from Quebec to New Orleans, and I have not seen any better mechanics than we have in New England. (Applause). There is some pretty heavy work done here. We have done about as heavy work right here in New England, right here in Boston, as they have anywhere. At the old Alger shop we cast 100 ton guns. We are doing about as heavy work as they are doing in most shops. At the Builders' Iron Foundry in Providence, with which I am in no way connected, they are doing pretty good work, and heavy work. I have been through Pittsburgh and Cleveland, and I want to say that right here in New England there are just as good founders, either at the wheel as foremen,

or digging in the sand heap, as they are anywhere. I am running a shop with somewhere from 250 to 280 molders, and I would like to know where I can get some real good molders at $1.50 a day. I will clean out the work round here if I can get them.

A Foundryman: Mr. President: If they will give us 500 we will take them with us.

Another Foundryman: Mr. Chairman: I should like a few of those. We pay ours from $4.00 to $6.00 for a day's work.

Vice-President Prince. The next paper is on Foundry Costs, by Mr. R. P. Cunningham, of Holyoke, Mass.

Mr. Cunningham added special interest to his excellent paper by giving it entirely from memory, to the envy of all the hard worked public speakers present. He received the liberal applause which his efforts elicited with becoming modesty, and the general hope was expressed to hear more from him at future conventions.

The time now becoming quite limited the paper was not discussed. This was also the case with the papers which followed.

Mr. Edward B. Gilmour read his paper on "Cores and Core Arbors."

Mr. James A. Murphy read his paper on "Shop Tools and Rigs."

The Secretary read a paper by Prof. H. R. Richards on "Technical Education."

Mr. Diller's paper on "Effect of Melting Steel with Iron in Cupola," was distributed among those present and brought out the following:

Discussion on EFFECT OF MELTING STEEL WITH IRON IN CUPOLA.

Mr. R. S. McPherran: We have all read Mr. Diller's paper with great interest. Experiments along this line are always full of profit. It is not, however, simply a matter of increasing the tensile strength. The question of how much steel it is advantageous or beneficial to use can be answered only by the question—Into what kind of castings is it to go? It is an axiom that the strongest test bar does not always make the strongest casting. In many cases the questions of shrinkage and internal strains are as important as that of strength. It is to be regretted

that the shrinkage and deflection of these tests were not given.

I doubt if any stated percentage of steel can always be relied on to turn out the best results. Conditions of melting are never the same. Size and purpose of castings vary so that it is only by experiment and observation that one can determine the analysis giving the best results for that kind of castings. It then becomes a question of working toward that analysis.

To emphasize the importance of the final analysis rather than the mere addition of any given percentage of steel. I would like to call attention to No. 10 and No. 11 in the tabulated results. Here it will be seen that the bar to which twelve and one-half per cent. of steel has been added, actually contains less carbon than the bar with thirty-seven and one-half per cent of steel.

To conclude, I will only add that in my experience, steel increases the apparent strength in a greater ratio than it does the real. That is, it will increase the strength of a test bar more relatively than it will increase the strength of the casting.

Adjournment.

Hardly had lunch been discussed when the dulcet strains of several bugles from without announced the approach of an imposing cavalcade of "Tally-Ho" and carriage. All Boston seemed to have been requisitioned to furnish the apparently endless train. Messrs. Carpenter and Gibby saw everyone well placed. Mr. Magee, with graceful courtesy dexteriously landed a box of Boston sweets wherever femininity lent its charms to individual parties. With the Chief of Police and his escort at the head the jolly procession swept down the broad streets of the city into the Back Bay district proper, past the wondering meeting of the Christian Scientists, whose presence there caused us such trouble with our certificates, and into the delightful park system which had all the elements of sea shore, country, and park combined in exquisite manner.

The strains of the bugle on the "official" coach mingling rag-time with the Doxology enlivened things, and occasional stops to rest the animals gave opportunity for snap shots on the part of our "Hansen." In this manner a most agreeable coaching trip was enjoyed, the many turns and varied scenery contributing to the delight of those participating.

The grounds of the U. S. Arsenal and shops at Watertown were made the first alighting place, the officers commanding being waited upon and invited to accompany us. The Colonel in charge of the Government Station was also thanked most cordially for the opportunity afforded in visiting a famous foundry and shop. A number of dissappearing gun carriages were in course of construction at the time, and the exactness of the work was much commented upon.

From here the procession turned to its objective point, the foundry of the Walker & Pratt Mfg. Co., which was soon reached. Far famed for its completeness and modern equipment. Where all manner of conveniences are provided for the workmen. Where molding is carried out on smooth concrete floors, and iron is carried about by trolley systems, we were, nevertheless, astonished to see the actual extent to which these labor saving and money making improvements were provided. A neatly printed guide to the works was handed each visitor. Men were stationed everywhere to properly direct the throng along the route mapped out, and explanations were given by the staff

of the establishment which aided a thorough understanding of the systems of work involved. The completeness of the arrangements for the benefit of the members of the convention may be seen when it is stated that even a drawing of the cupola was attached to it, to show the arrangement of the air entry.

On the lawn of the beautifully laid-out grounds surrounding the works, a tent had been erected, and a long table within groaned under the load of the good things provided. The assemblage did full justice thereto, for the long drive had sharpened the appetites. Everywhere the officers of the company, as well as the Entertainment Committee, were busy making everyone at home, and when the assemblage left again, three hearty cheers were given Mr. Walker to show the appreciation of the splendid reception.

Going back a different route, opportunity was given to see the venerable town of Cambridge. As the cavalcade passed through the grounds of Harvard University, doubtless many of the young men there wondered whether they would ever be identified with the world's progress as exemplified by our industry.

Arriving at headquarters, dinner and a short rest brought us to the next number on the programme. This was a "smoker," and a thoroughly enjoyed one, too. A profusion of good cigars, mild and semi-dangerous beverages, pipes and pouches of special tobacco were found on all the tables. Lunch came later in the evening, while a splendid round of vaudeville made the evening pass all too quickly. Returning with souvenir mugs, the delighted crowd wended homeward to find that the ladies had been similarly entertained in the assembly hall of the hotel by the indefatigable committee headed by Mr. Brown.

Thus ended the second day of the convention. This also had blended enough business and pleasure to fill out two days of ordinary life.

THURSDAY, THE 19th.

The morning and afternoon was given over to a steamer ride on the beautiful bay of Boston. A number of the members, however, by special arrangement with the Institute authorities, visited the chemical laboratories thereof, and were much interested in the equipment provided and the methods of instruction in vogue. One would think there was hardly room enough to house so many different sub-divisions of instruction, and the Massachusetts Institute of Technology is to be congratulated on its work in the interest of technical pre-eminence on the part of this country.

The members of the convention now took the cars to the boat, and embarked on what proved a most enjoyable trip, in spite of the rain which up to this time had kept carefully away. It proved only a passing shower, however, and in no way interfered with the general enjoyment of the day. Lunch was served on board to shorten the wait for the elaborate "Shore Dinner" afterwards provided at Nantasket Beach. The scenery about Boston harbor is beautiful, and was thoroughly appreciated by those on board, as was also the excellent music arranged for by the committee.

The memory of a "Shore Dinner" will linger long in the minds of those who have never before attacked a menu with clams in five different styles, and every variety of fish to be had about Cape Cod. All the other good things which went with it would make a society reporter feel envious. Suffice it to say that on this excursion ample opportunity was given for old friends to meet at leisure, new connections were made, the foundry foremen got together, the Nominating Committee performed its work, and general good fellowship reigned supreme.

Returning to Boston, the elevated railroad was taken, which at one place goes under the subway for the surface car, and headquarters was reached in time for dinner, and the business session to follow.

The last business session of the convention was held in the smaller hall of the Institute of Technology, this room lending it-

self better for the presentation of diagrams and stereopticon views, incident to Mr. Saureur's lecture.

Vice-President Best called the convention to order, and called for the report of the Committee on Nominations.

Mr. Yagle: Gentlemen: The Nominating Committee suggest the following names for officers of this Association for the ensuing year:

For President, Mr. W. A. Walker, of the Walker Pratt Manufacturing Company, Boston.

For Secretary, Dr. Richard Moldenke, of New York City.

Before announcing the name for Treasurer, I wish to state that Mr. West has declined to serve again, owing to pressure of business. We suggest the name of Mr. Willis Brown, of Erie, Pa.

For Vice-Presidents: First District, Mr. J. F. Lanigan, of Lawrence, Mass.; Second District, Mr. J. A. Becket, of Hoosic Falls, New York; Third District, F. H. Zimmer, of Pittsburg, Pa.; Fourth District, Mr. A. I. Finley, of Cleveland; Fifth District, Mr. Christian Wolff, of Chicago, Ill.; Sixth District, Mr. Adam Baer, of Milwaukee, Wis.; Seventh District, Mr. J. P. Golden, of Columbus, Ga.; Eighth District, Mr. T. J. Best, of Montreal, P. Q.

The committee would further suggest that the Executive Board of the American Foundrymen's Association take into consideration the appointment or otherwise of an assistant to the Secretary.

Vice-President Best: Gentlemen: You have heard the report of the Nominating Committee. What is your will and pleasure concerning it?

Mr. Seaman: I move that the Secretary cast a vote for the entire list. (Seconded and carried).

The vote was then cast by the Secretary, and the several nominees were declared elected officers of the Association.

Vice-President Best: (The President-elect came to the front of the platform). Mr. Walker, I take great pleasure in presenting you to the Association and assuring you of its hearty good wishes.

President-elect Walker: Mr. President and Gentlemen: It is, indeed, a very pleasant thing to think that in this room,

where twenty-three years ago I was taught the first principles of physics by Prof. Cross, I should have the honor of being elected President of the American Foundrymen's Association. Many of the facts that I was taught in this room I have forgotten long ago, but I hope I never shall forget the time when you were so kind as to elect me to this position of President. I thank you very much, Mr. President and Gentlemen, for the honor that you have conferred upon me. (Applause).

Dr. Moldenke: Mr. President: I also would like to add my sincere thanks for the kindness in continuing the honor that you have conferred on me, and I hope that I will be able to do even a little more next year than I did the last. I thank you very kindly, too.

Mr. Seaman: Mr. Chairman: I wish to make a motion to return thanks to the New England foundrymen, and its committees, for the kind and hospitable way that they have treated this convention and its members while here at this meeting. I make this motion not as such motions are ordinarily made. I make it with the sincere feeling, which, I think, will agree with that of all the members present, that we really, truly wish to return our sincere thanks for the kind reception we have received. (Applause).

Motion seconded and adopted unanimously.

Mr. Bell: I am authorized by the ladies in attendance on this convention to return their sincere thanks to the Committee on Entertainment for the splendid manner in which they have provided for their entertainment, and they wish these thanks to be put upon the minutes of the proceedings of the Association. These words faintly convey the feelings of the ladies in regard to the matter. There is a more eloquent expression in the bright eyes and winsome smiles of the ladies themselves, which have been cast upon the individual members of this entertaining committee for their much appreciated efforts. While the ladies have but little in common with the general business of this convention, or the details of the foundry business, still they have much to do with molding the character of the future foundrymen. They wish me, further, to ask for a hearty vote of thanks for the very successful provisions made to entertain them, and to express the pleasure it would be to remember their visit for many years. (Applause).

Vice-President Best: Gentlemen, it has been regularly moved by Mr. Bell, one of our past Presidents, and seconded by several gentlemen present, that the vote of thanks from the ladies should be tendered to the Entertaining Committee of the New England States, and that the words be inscribed on the minutes of our meeting.

The motion was adopted unanimously by a rising vote.

Vice-President Best: Mr. Bell, will you kindly convey to the ladies the appreciation with which their motion has been tendered and accepted?

Mr. Bell: I will, sir.

Mr. Prince: Mr. President: I move a vote of thanks also to those members who have so earnestly labored in the intellectual line by furnishing the papers which have been more or less discussed. If it would have been possible we could have had a fuller discussion of some of them, because I recognize many of them are of extreme value. They could have been talked over more than they have been. I think they are deserving of the hearty thanks of the Association. I would also, at Mr. Seaman's suggestion, most heartily mention our worthy Secretary for the labors which he has performed. These, somehow or other, always go without mentioning.

Motion seconded and carried.

Mr. Zimmers: Mr. President: I think that we should also tender a vote of thanks to the Walker & Pratt Manufacturing Company for the very nice way in which we were entertained yesterday. (Chorus of "second the motion").

Mr. Walker: Mr. President: I should be very glad if the motion did not prevail. I hope you will not place me or members of my company under any further obligation. The pleasure was ours, and we certainly did not desire any further thanks than your presence at our factory.

(The motion was adopted unanimously by rising vote).

Vice-President Best: Thank you. The motion prevails. Mr. Walker, you see by the standing vote the appreciation of the way in which your efforts for the entertainment of the Association have been carried through. For myself, personally, I can assure you that it has been a great pleasure to me, a greater pleasure than I can possibly give expression to, to visit your

works and its surroundings, and not only so, but to be treated so royally as we were treated there.

Mr. Stupakoff: Mr. President: I think we have omitted to express our thanks to the Institute of Technology of Massachusetts for their kind permission to use their hall. I would request that that be placed on the minutes, too, and our sincere thanks be tendered to them as well.

(The motion was seconded and carried).

The Secretary: Mr. President: I would like to say a word in connection with the certificates. Unfortunately they did not go through. There are only sixty-nine of them, and the rules of the Trunk Line Association of New England are so strict that we could not do anything about it. But I would suggest that when you buy your tickets home for the full fare, you get receipts for the tickets, and that you get the certificates, and pin them together, and write a pretty strong letter to the general passenger agent of the line you bought your tickets from, explaining the situation, that there were over and over enough members to get the rebate, but that it was not allowed because most of them got tickets from the Christian Scientists. I understand that the western roads, especially, will very likely give you the rebate, and that will be at least some consolation. We are sorry we could not secure the reduction, and this is the first time it has happened in our history.

Now, Mr. Chairman, I would like to bring up another matter. Where is the next convention to be held? I have received during the last few days telegrams and letters, especially from and through our member, Mr. Adam Baer, whom you have made Vice-President of the district, including Milwaukee, urging that this city be selected as the place for holding the next convention. This invitation has been supplemented by letters from the Mayor of the City of Milwaukee, and from the Board of Trade. We have no other invitation to record concerning the next convention, so if you wish to place the matter into the hands of the Executive Committee, or wish to decide now, it is awaiting your pleasure.

Vice-President Best: Gentlemen: You have heard the invitation given from Milwaukee by several gentlemen there, and you have heard the words of Dr. Moldenke. The subject is

open for discussion. There might be other places, perhaps, that some of you would like to have the next convention held in, but it seems to me that this being the only invitation received so far, the matter might be discussed at the present time.

The Secretary: I would like to add that the only other available place would seem to be Cleveland. We have practically no members there at all, and it might be good, of course, to hold the convention there to get members. Milwaukee, however, has now asked the second time.

Mr. Seaman: Mr. President: I believe it has been the custom heretofore that the Executive Committee decided where the convention should be held, and I think we might leave it in their hands again.

The Secretary: I would like to make a further announcement that we also have an invitation from St. Louis, from the Board of Trade, and from some of our friends down there, to hold our convention the year following in that city. Mr. President, we have now only a few matters to discuss before we go to the papers for the evening. I believe that we would like to hear from the executive officers of the Foundry Foremen's Association, who are here to-night, and who would like to address us on the subject of mutual relations between the two associations. I think the President of the Foundry Foremen's Association is with us to-night.

Vice-President Best: You will kindly come to the platform and express your views on the matter.

Mr. Loudon: Mr. President and Gentlemen of the Convention: The work of the Foundry Foremen's Association has been discussed considerably at this convention. This is an Association that was organized about fifteen months ago, in the City of Detroit, by Mr. Hansen and Mr. Thomas. Previous to that, Mr. Thomas and I had talked this matter over while he worked for me in Ansonia. Our idea was to get up an association for the betterment of foundry foremen. We felt that foundry owners had the National Foundrymen's Association for the protection of their interests, foundry owners and foundry foremen combined had this American Foundrymen's Association, and the molders had their Association. We as foremen were on the wall, with an association on each side of us, and if we wanted

any assistance in our laborious work in the foundry, we could not well get it in the office, and certainly we did not get it from the molder. Some of us have been unfortunate enough to be in a position where we have found ourselves shy of that knowledge necessary to carry us through many a difficult problem that has come up before us. The originators of this movement thought that if we could form an association of foundry foremen for the purpose of exchanging ideas and to help one another along it would be a good thing. Our road was rough, and we wanted to see if we could not get something up that would make it easier. So we started this movement off, sent circulars all round the country to the number, I think, of a thousand. Quite a number of the foremen here at this convention to-day claim that they have never received any notice, did not know that there was such an association in existence. I know of many a case myself where circulars were sent to a foundry but never got beyond the waste paper basket. And we felt that while some owners looked at the movement in the proper spirit, a benefit of a foreman being a benefit to them, other owners looked on it as if it was something of a detriment to their interests. We have brought the question up here, while we had so many foremen together, so that we could get their views better than we could by sending out all the literature we could conceive of. We had a meeting last night in a corner at the "smoker," and we continued the meeting this morning. There were quite a few very nice suggestions made for the success of this association, that is living, but that is about all. We have in the fifteen months got between forty and fifty members. And several of the members of the American Foundrymen's Association have been much interested in hearing more of it to-day. I myself had a talk with the Secretary of this Association, and I told him just about the lines that we were trying to run this thing on. He thought it was a very good idea, and suggested a combination of effort on the part of the two associations.

Mr. Hansen: Mr. President and Gentlemen of the American Foundrymen's Association: Mr. Loudon I believe has covered this ground very fully, so far as the objects of the Foremen's Association are concerned. Some doubt has existed in the minds of foundry owners, who seemed to think that

the foundry foremen of this country were trying to form an association which would follow the lines of the Iron Molder's Union, and that if they could not obtain any request they made they would strike for it. This in itself is absurd, because we all know that nearly every molder in the shop is willing to become a foundry foreman if he only can. I want to say to the foundry owners who are here present that our organization is not formed for the purpose of enforcing any demand, but for better enlightenment of the foremen, and to put them in position to help one another. I have always contended that if they could not help themselves nobody else would help them. In regard to affiliating with the American Foundrymen's Association, it is very well in all undertakings to have a central head, and I feel that the Foremen's Association really would be much more useful while affiliated. At the same time, I believe it should be optional, just like the local Foundrymen's Associations, whether they belong to the American Foundrymen's Association as individuals or not. There is a certain benefit to them in reduction of dues, and they receive all the papers which are published.

The Secretary: It would be possible to come to some arrangement by which the members of the Foremen's Association may become members of the American Foundrymen's Association, under certain fixed rules of dues, etc., which can be devised by the boards of both associations getting together. Possibly the best thing would be to make a motion to that effect. If it is possible to get them together, we get the advantage of the foremen belonging to us, as members, and you get the advantage of our publications coming to you and coming to the conventions, meeting with wide awake foundrymen, with all that this means.

There was considerable discussion on the ways and means of getting together, and further explanations seemed in order.

Mr. Ludon: Mr. Chairman, I would like to add a word. You can readily see that any foreman, according to the constitution of the American Foundrymen's Association, is entitled to put in an application to become a member, and he will do well to join it, but we really need more. Suppose a foundry foreman was in great difficulties in his foundry, something going

wrong,—and that is liable to come up any day,—and the owner was feeling a little rusty about it, feeling sore, too many by-paths, cost going up too high. That poor unfortunate foreman could be tided over if he had some helping hand just to give him a tip where he was going wrong. It is impossible, at least I think so, for an organization combined of foremen and owners, to help here because none of the men would feel like giving himself away. Few owners will know how to help the foreman, and yet he is greatly in need of the answer. The Foundry Foremen's Association is formed just for the purpose of assisting one another where they are in difficulties. A man doesn't need any assistance if he is going all right, but a man that is going along all right sometimes can help another man that is not just as fortunate as he is. That is the reason why this Foremen's Association was formed without considering membership in the American Foundrymen's Association. In forming it we knew there were quite a number who were members of the American Foundrymen's Association, when we were asking them to become members of the Foundry Foremen's Association; but one reason why the Foundry Foremen's Association was formed was because a man is sometimes timid, he doesn't know just where a question asked might turn up, he doesn't know who might hear about what he asked, or what might happen, and the result is that he would not ask it anywhere else but would go on in the old rut until he would either be discharged or some other thing would happen.

Mr. Bell: Mr. Chairman, I wish simply to make a suggestion. We have a great deal of business to perform here this evening. While it is very interesting to hear these gentlemen discuss this question, which is a new one that has been presented, we have made ample provision in our constitution for just such cases as this, and I don't see any reason why the Executive Committee cannot promptly act upon the question on this basis. We have a provision in the constitution that members who apply for admission to the American Foundrymen's Association shall pay $5 as dues, whereas for outsiders, like myself, it is $10. Now, these gentlemen have formed an association. It has an alliance with this business, with this object that we have in view. Why can't they come in under that provi-

sion? If the ground was free from other questions I would make a motion that the Executive Committee be authorized to admit these foundry foremen under that clause of the constitution. They are eligible as it is, only there is the question of the amount of dues that they would be required to pay. Without some action of this kind, recognizing their association as an association associated with this, they would be charged $10 a year, but by recognizing this association as one that is an adjunct to the business, why, they would be entitled to admission at $5. I think that is the solution of the thing if you discuss it five years.

Vice President Best: Gentlemen, you have heard the motion already made, that the Exècutive Committee of this Associaciation and the Executive Committee of the Foremen's Association should discuss the matter of consolidation of effort, and that our Executive Board be empowered to act.

There was considerable discussion on this motion and on voting, a division was called for. The motion, however, prevailed on counting the ayes and noes.

The Secretary: Mr. President, I would like to say, for the benefit of harmony, that if the gentlemen who voted no will kindly give their reasons to the Executive Committee it will be a great help in deciding the question at issue. There might be something that could be cleared up. Now, Mr. Chairman, there are only a few things to come up yet. I think some of our chemists present would like to say a word.

Mr. Flintermann: Mr. President, if I may have just a few minutes. There are a number of gentlemen present who are perhaps more interested in the metallurgical part of the foundry business than in the practical part, and I have heard an expression of opinion given a number of times to this effect: that it would be a pleasant part of these meetings if we could have a little programme by ourselves, in which we would discuss metallurgical problems alone. These discussions, perhaps, would be too tiresome for the whole body. The idea that we had was that a committee be appointed at this meeting, and that they should get up a programme, perhaps, a number of papers, which should be read at a special chemical session, which should meet in connection with this association at a time set, say an hour pre-

vious to the general meeting, so that this special metallurgical or chemical session would in no way interfere with the regular business of the association and yet be open to all. If I may be permitted I move that such a committee be appointed. (Motion seconded).

After some discussion regarding the scope of the proposed idea it was finally thought good to establish a metallurgical section as part of the association, to meet in separate session at the convention, the session, however, being open to all. In this manner purely metallurgical or chemical questions, of lesser interest to the practical foundryman, can be discussed more freely. The motion prevailed. Mr. Flintermann was appointed chairman of a committee to devise ways and means to carry this idea through, and was empowered to select his own co-workers.

Dr. Moldenke: Now, Mr. Chairman, there is one more thing before we get to the papers. One of our members present made a very good suggestion. I cannot now recall his name; it is that a committee be appointed to study the question of recovery of nickel from the anodes used in the nickel plating process, which many of our foundrymen make use of. If the gentleman is present he can probably explain it better than I can; but if he has gone home we will have to let it lie over to next year, but I just mention the fact that it is a subject that should be of considerable interest to foundrymen, a great loss is incident to the incomplete use of the nickel of to the anodes. This has to be retreated and is then sold back to you, at some loss. Now, there is something we might look into during the year with a view of helping those of us who do metal plating.

Mr. Slocum: I believe this is under new business. I only want about two minutes. I have been requested by several members of the association to make a few remarks concerning certain statements made by members of this association at various sessions, and before previous sessions, somewhat to the effect that the foundries and foundrymen in the last thirty and forty years have made no progress, that they are standing still, that as compared to other arts and other trades they are not in the same race. The easiest way I can refute that is simply to refer to my own experience; therefore that is what I speak of. My experience has been in the line of brass founding, cast

iron pipe, radiators, general founding, and car wheels. Any man who will get up to-day and state that thirty or forty years ago he could make brass castings, bronze or false bronze, as the case may be, to meet our present specifications and analysis, would be taken as a joke. Any man who would get up and state that he could make pipe with our present processes, at three pipe to a flask for small sizes, without our present power machinery in the way of trains, drums and rolls, and handling of our heating ovens, and for boring and other processes, would simply be told he did not know his business. The better way to put the statement as to car wheels is this: in the last fifty years our specifications and tests and requirements have increased in the neighborhood of 250 per cent. We are meeting those requirements to-day better than we were when they were 250 per cent. less than they are now. In radiators we are making them to take a severe test, a closer inspection, of one half the weight, for one quarter the price, and more artistic and to meet the requirements better. As for the general jobbing department, I will simply state that if any man should get up on this floor to-night and say he had been in the foundry business for fifty years and was not making better castings at a lower price, he would not be wanted by any of us as a foreman. I think statements of that kind should be taken and carried forth for what they are worth. A man who thinks he has not made any progress may think so from his own experience, but he should not be entitled to so express himself. Mr. Lobdell supplemented these remarks by citing from his own experience with roll and car wheel work, quoting the common practice of formerly cutting the journal of a roll out of the solid chilled portion, as it was impossible to make the roll casting than as it is now.

The question was debated at some length by Messrs. Lobdell, Slocum, West, Gilmour and McPhee, and as a question like this has two sides, the manufacturers of special lines showing enormous progress, while the back-counting foundry shows none, it was resolved

That the foundry has advanced greatly within the last thirty years, and that anyone claiming the contrary does not voice the opinion of the association.

Motion debated and carried. Mr. Lobdell promising to speak further on the subject at the next convention.

The papers for the evening were now taken up. Mr. Field presenting the subject of the "Metallurgy of the Cupola." Mr. Stupakoff followed next with his two papers on the "Molding Machine," discussing the subject of jigs and flasks for this class of foundry apparatus. As Mr. Stupakoff added much matter of interest his remarks are given in full herewith:

Discussion on the MOLDING MACHINE.

Mr. Stupakoff: Gentlemen, I have had the privilege to bring you a few papers in the proceedings, describing some mechanical features which are frequently used in the foundry, and I have been requested, especially by your Secretary, to bring some information about molding machines and combine the whole thing in a continuous series of papers. Those few papers which I brought before have described some parts which do not seem to have any intimate connection with molding machines themselves, and it may have appeared to you that what I have said in those papers should not have come under the head of the molding machine; but I expected, in bringing you further description of the matter and treating the matter fully, to show you the intimate connection which all these little parts which I have therein described have with the molding machines themselves. A molding machine is generally considered by all foundrymen as a thing by itself, and if a foundryman, or a foundry owner, or a foundry foreman, or a molder, has a molding machine in his hands or in the shop he thinks that machine by itself is a complete thing. That is a wrong idea, and it was my intention in describing these details in connection with molding machines to point out the mistake which is generally made in this direction. I have used a great many molding machines, of a great many different kinds, and I have always found that a molding machine is of no use whatever unless it is used judiciously and unless it is in the hands of an intelligent man. You may place a laborer on a molding machine after you have rigged it up for him, but unless you keep all the tools of such a machine in good condition it will not give you the desired service. Among other things, if a molding machine is brought into a shop it is oftentimes expected that it shall make all kinds of castings. That is an entirely wrong idea. A machine is always limited to a

certain size and certain depth and certain style of castings. If a molding machine maker tells you that his machine will make 200 or 300 flasks, and I have seen it described that a machine will make a thousand flasks, you had a great deal better keep your hands off that machine; but if a man comes to your shop and says, "I will possibly effect you a saving of 25 or even 20 per cent. in the cost of your castings," I think you have a perfect right to place confidence in that man. But that machine which is recommended under those conditions will not even give you this 25 or 20 per cent. saving unless it is used judiciously, and unless certain attention is paid to the details, to jigs, or to flasks, which are used in connection with it. The greatest difficulty which is generally found with the use of molding machines is the placing of patterns on the table of the molding machine, and I have endeavored to explain to you a simple, perhaps the simplest way of all in one of these papers, which I have headed "Jigs." As a jig this contrivance may be known, especially by machinists or mechanics in connection with a machine shop, while in foundry practice it is called frequently a transfer plate. Under that name it is oftentimes known by the molders. If such a transfer plate or jig is in the hands of good mechanics they will be able to make use of a molding machine, even in the jobbing shop, where a molding machine was never of any use before. Ordinarily you cannot use a molding machine for castings which are poured in small quantities, but if you have the means of placing patterns on a molding machine quickly, we will say in half an hour or an hour fill the table of a molding machine, it may be oftentimes of an advantage to turn out a small order in the jobbing foundry—we will say of 50 or of 100 castings—on such a machine, but that cannot possibly be done unless you are provided with the certain tools for doing it. Your machine must be made in the first place practically perfect, and the jig or the transfer plate which is used for that purpose must also be made by good mechanics. The work is generally left in the hands of pattern makers. Pattern makers will usually make an accurate job, but if you have a mechanic, or I won't say a mechanic, a machinist, a good machinist or tool maker around your works, he will generally be able t operform such a job to better satisfaction. After such a jig as I have described in this

paper is in your hands, and you have an ordinary kind of a pattern, and you want to make perhaps fifty or more castings on your machine, you place this pattern on any convenient place on this jig, place it in a frame, and drill holes into one half of your pattern, we will say, providing the pattern is split. Then place the other half of the pattern against the first part, drill through both of them. Next place the plate, this jig plate, on the table of the molding machine, and drill through the identical holes with which you have drilled your patterns into the table of the molding machine, and you can place the patterns correctly on the table, so that if the flask is turned you can make out of a single pattern double the amount of castings in one flask, which generally will be found of an advantage in ordinary foundry practice, and which especially if of advantage in jobbing foundries if there is only one pattern at hand. If the tables of molding machines should have been provided before hand with an identical number of duplicate holes as in the jig which is used for drilling your patterns, then you save yourself the work altogether of drilling the table of the molding machine each time, which is really quite unnecessary. The holes I have found by experience in a table are not at all objectionable in casting, but if they should be they are very easily closed up with a little beeswax. If you have once used such patterns on a molding machine you can fill the table of such a molding machine—or drop table, it is not necessary that it should be a molding machine, a drop table is just as good—within about fifteen minutes completely with patterns, and you have your molding machine ready for work. Those are points which are very seldom known by foundrymen, and on that account I thought it would be perhaps of advantage to bring them to the attention of all the gentlemen present. Besides, I mention in the second paper, which forms the fourth chapter of this general paper on molding machines, something about flasks. There has been so much said about these things that it is hardly necessary to go into the detail. I merely call attention to the necessity of keeping the flask in first-class condition. It is not sufficient to use flasks in connection with any machine molding or drop plate molding which are maksshifts. You will never be able to make such appliances a success in your foundry unless you have first-class flasks, and these flasks, of

course, must be kept in the first-class condition. You have the papers before you, when you have leisure time after getting home you may be able to study and read them a little bit, and I shall be glad to hear your comments on them.

Mr. Albert Sauveur now delivered a most interesting lecture, an outline of which, appended herewith, was handed to those listening to make it more easy to follow the speaker. Mr. Sauveur has promised us the manuscript and it wall be published in full later on.

BRIEF SYNOPSIS OF AN ILLUSTRATED PAPER ON THE APPLICATION OF METALLOGRAPHY TO FOUNDRY WORK.

Remarks concerning the close analogy between the structure of cast iron and the structure of steel.

The appearance of wrought iron under the microscope.

Change of structure due to the introduction of a small amount carbon converting of thereby the iron into soft steel.

Structural changes produced by an increase in the amount of carbon.

The structure of medium-hard and of hard steel.

White cast iron considered as a very high carbon steel.

The structure of white cast iron.

Absolutely gray cast iron is made up of a matrix of iron and particles of graphite.

The structure of gray cast iron.

Cast iron containing both graphite and combined carbon is made up of steel matrix and particles of graphite.

The structure of gray cast iron containing increasing amounts of combined carbon.

Relation between the strength of cast iron and its structure.

Value of the microscope in revealing the presence or absence of the structure corresponding to greatest strength.

The influence of the rate of cooling, of silicon and of other impurities upon the structure.

The detection of phosphorous under the microscope and its effect upon the structure.

Effect of chill upon the structure.

On motion Mr. Sauveur was thanked by a rising vote. There being no further business the convention adjourned.

OCT 21 '5

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. SEPTEMBER, 1902. PART II.

DISCUSSION ON THE MELTING RATIO.

Mr. E. E. Russell Tratman, of Chicago reports to "The Engineer" of London on American Foundry Practice. In the issue of December 6th, 1901, he discusses the melting ratio. We give it herewith. "In some discussions as to the relative merits of different cupolas, or the efficiency of the work in different foundries, it has been assumed that the melting ratio—or the amount of iron melted per pound of coke—is a proper basis for comparison of results. This is entirely erroneous, for various reasons, the most important of which is that the proportion of iron to coke necessarily varies very considerably according to the character of the work to be cast. For small, thin, or intricate castings the metal must be very hot and fluid, requiring the consumption of a considerable quantity of coke, while large roughwork can be cast with iron at a lower temperature, and consequently with a higher melting ratio. Other reasons which weaken the comparison are the lack of uniformity in figuring the the quantities involved, the variation in the quality of the pig iron and coke, the size of the cupola, the total amount of the melt, and the length of the heat of the blast."

In the series of articles on "Cast Iron Pipe in the United States," published in "The Engineer, ' February to July, 1901, the general average of regular daily work was given as 10 lb. of iron per pound of coke, including the bed, although one of the pipe foundries described had a record of 12 to 1. An English critic claimed that 10 to 1 was very low, and intimated that his patent cupola could give ratios of 12 or 16 to 1 with a melt of 80 to 100 tons, and even better with small heats. No details were given as to the class of work, the conditions of working, or whether the figures included the bed. The

present writer has no desire to institute invidious comparisons between American and English practice—there have already been too many such comparisons, made on insufficient and unequal bases; but it is fair to say that English records of foundry work do not appear to sustain such high claims for regular work. Ratios of 12 to 1 and even higher have been made at American foundries, but they usually represent special conditions and not regular daily practice. Two pipe foundries, however, even report records of 14 to 1 and 14.6 to 1. The latter was for very heavy pipe, which did not require very hot iron, and this was not considered satisfactory. In fact, it is generally recognised as poor practice to cut the coke supply too fine, at the risk of losing castings by having dead iron, cold shuts, etc. The character of foundry coke has already been discussed.

Particulars of the melting ratios of certain makes of cupolas have been given above under the heading of "Cupolas." Following up the English Criticism on this matter, the writer instituted some inquiries among foundrymen of acknowledged experience and foundries making different classes of work. From the replies received the following notes are taken :—

(1) Dr. Richard Moldenke, secretary of the American Foundrymen's Association, writes as follows :—"Your figure—10 to 1—is an average of the best American cupola practice, and that only for heavy output—50 tons and over—of uniform work. A good average for a jobbing foundry is 1 to 8½, more often it is 1 to 8. For small blows it is impossible to get over 1 to 6. My own results with an output of 15 tons was 1 to 5·8 ; 25 tons, 1 to 8·2 ; with 54 tons, 1 to 10·1. This, for railroad castings of uniform shapes and weight, with some heavy work thrown in, all in the same cupola. The best figures I ever obtained were in melting white irons for heavy annealing pots, in which work I could save coke, as the iron was not wanted hot. Here I got 1 to 11.8, and the heat was 65 tons. The very small heats used for cupola 'malleable' amounting to only 4 tons, seldom go better than 1 to 4."

(2) Mr. W. J. Keep says—"The amount of fuel required to melt iron depends on the kind of work to be poured. For very heavy castings it would be possible to do better than 10 to 1, but for light machinery it would be less, and for light hardware, &c., 9 to 1 would be good ; and 7 or 8 to 1 is also good. We melt

more economically in the United States than they do in England. Iron hot enough to pour a casting ¼in. thick was never melted with 16 to 1. Much depends on the method of figuring, and whether all materials are actually weighed. The proper way is to weigh all material, and count all coke in bed and in each charge. The coke and iron recovered in the dump should not be weighed, but should be charged next day along with new material, or else subtracted from the day's iron and weighed next day."

(3) Mr. Scott, whose foundry investigation work and foundry material specifications have already been referred to, says that at the Case foundry—making agricultural machinery—the melting ratio is about 1 to 8, but varies from 1 to 6 and 1 to 9, the latter figure being seldom attained. Much depends upon the size of the cupola and surrounding conditions. With a ratio of 1 to 6 you are sure to get a good hot iron ; with a ratio of 1 to 10 the chances are favorable to cold iron and trouble with 'cold shuts.' Ordinarily, 1 to 15 is impracticable,and when such cases are reported it is usually found on investigation that the foundryman forgot to include the 'bed' of coke. There is no economy in spoiling 15 tons of high-priced iron for the sake of saving half a ton of cheap fuel.

(4) At the General Electric Foundry, already described, the records for the past year show that for this period the ratio is a little over 9 lb. of iron to 1 lb of coke, which, in their opinion, represents about the average result obtained in large ironfoundries. They have however, kept records of individual melts where they were able to obtain over 10 lb. of iron to 1 lb. of coke, but this was where the conditions were very good and the melter was looking after the charge very carefully.

(5) "You have asked a question which is difficult for us to answer definitely, if the information is to be used for general purposes, for the reason that if we are given equal conditions as to cupola, volume and pressure of blast, &c., the melting ratio of coke depends principally upon two factors; the first being quality or composition of material being melted, and second, whether the blast is continued throughout the heat, or frequently interrupted on account of lack of facilities for taking away the metal. In the case of melting an all pig iron mixture for fine machinery castings, a ratio of 8 to 1 is considered fair, whereas a ratio of 10 to 1 we would consider as firstclass. However, if we were to melt, say, 40 per cent. of pig

iron containing about 2½ per cent. silicon, the remaining 60 per cent. to be made of all miscellaneous scrap iron, we expect, and do get, a result of 12 and 13 to 1 as an average. These figures are, of course, inclusive of the bed. I never heard of as large a ratio as 16 to 1, but if nothing but cheap scrap were melted, no doubt such a figure would be possible. Your figures of 10 to 1 as a general average I believe to be perfectly correct, and I base this belief upon the experience of some fifteen years' work."

(6) At the McCormick foundry, making parts for agricultural machinery, the average melting ratio is somewhat better than 10 to 1.

(7) The Westinghouse Company writes as follows:—"We buy our coke by the carload, and the weights given are all railroad weights. We are frequently compelled to pass railroad weights which are in excess of our own scale weights. During the year 1900 we purchased for our East Pittsburgh foundry a total of 3,731,000 lb. of coke. A certain proportion of this, impossible to account for accurately, was used in our brass foundry for melting stock in crucibles; a certain other proportion was employed in the making of cores, in order that the gases might be conveyed away readily in the core; a certain amount was probably employed in building open fires during the severe winter weather while our building operations were going on. If we dealt with the total coke purchased and the total iron melted, then we have a very low ratio, viz., about 5 lb. of iron per pound of coke. If, however, we depend upon the cupola man's detail reports of iron melted, and coke used, our average runs up somewhat higher, and the ratios, according to such reports, are more nearly 6½ to 1. We believe that there is a great deal of fallacy about the high reports which are oftentimes seen in print. Our practice is probably as good as the average foundry in this respect, and we are disposed to think that where ratios are high as 10 to 1 are reported that the party so reporting them is simply fooling himself. If he had the ways and means of comparing the total coke bought and paid for with his total iron melted he might discover a wide discrepancy. Our heats, as a rule, are comparatively short; we endeavor to melt as fast as we possibly can, in order to delay the time for our first pouring to as late in the afternoon as will enable us to finish up the day's work by our regular quitting time. As a consequence, our cupolas have to be charged on the first bed as usual, no matter how short the heat might be; and when we dump

the cupola at the close of heat we have the constant waste which is incident to this end of the operation. If we were melting continuously, as some foundries do, or as the Bessemer steel works frequently do, we would reduce very greatly the average loss at both ends of the melting, and make a better showing. In addition to this our castings are largely of the critical sort, and we must have our melt good and hot. We make this explanation to in part justify a ratio of coke to iron which might seem to be woefully poor. We have good cupolas, of most modern construction, and we feel that they are operated to fairly good effect. We run five cupolas in our East Pittsburgh foundry, although not always employing the total number, since our heats vary in size from day to day."

(8) "The average of 10 to 1 would be a fair proportion for melting iron for cast iron pipe purposes. We have melted as high as 14.6 tons of iron to 1 ton of coke in melting very heavy pipe. This is not a satisfactory ratio to work on, and we believe that your average melting ratio of 10 to 1 is as fair as possible to get. For light castings, stove plates, &c., an average of 1 to 7 is required."

(9) "As to our relative ratios for melting in our cupola practice for cast iron pipe, I beg to advise you that between 13 lb. and 14 lb. of iron to 1 lb. of coke is our usual practice when we are running our cupolas at their maximum. This includes beds."

(10) The Schenectady Locomotive Works reply that it is the practice of their foundry of melting 10 lb. of iron to 1 lb. of coke. The 72-hour Frick coke is used.

(11) The R. D. Wood Company, whose pipe foundry has been described in detail, state that the melting ratio depends so much upon the details surrounding each case that it would not be fair to make any general statement. "We have no doubt that in some of our cupolas we are using as much as 1 lb. of coke to 6 lb. of iron, while in others it may be as much as 1 lb. of coke to 15 lb. of iron. Pardon us for not being able to give a general average. The maximum or minimum are really all that is safe to speak of."

(12) Two makers of cupolas give the following replies:—(a) "Our experience is that 10 to 1 is a good ratio of iron to coke in cupola practice. It must be that the high ratio of English cupolas does not include the bed. We have known of ratios being compiled in this way before, but they would run even higher than 15 or 16. The best results are, of course, to be obtained in the larger

sized cupolas and when running long heats." (b) "We believe that you are misinformed, not perhaps intentionally, but nevertheless erroneously, concerning the ratio of melting in England, especially in small heats where you state they claim to run from 15 to 16 to 1. We have some records of our furnaces melting as high as 14½ to 1; we consider this exceptionally high, and in our travels about the country we find that 10 to 1 is considered good melting, and information we have heretofore received from England would lead us to believe that a much lower ratio was run, running down as low as 5 or 8 to 1."

DISCUSSION ON THE STANDARDISATION OF CAST IRON PIPES.

The Iron and Coal Trades Review, August 1st, gives the following on this subject:—The British Association of Waterworks Engineers recently appointed a committee to report on the desirability and feasibility of adopting some satisfactory basis for standardisation of cast-iron pipes, and the amount of support likely to be secured in the event of the matter being put into practical shape.

With this object in view a circular was drawn up containing the following questions, –

1. Do you consider it generally advisable that the dimensions, weights, etc., of cast-iron pipes should be standardised in this country?

2. Are you of the opinion that such a standard could be arrived at as would prove of general application?

3. Would you be prepared personally to assist (a) in the formation of such a standard, and (b) by the adoption as far as possible of standard pipes, in your own case?

4. General remarks on the subject.

This circular was sent to all members of the Association in active charge of waterworks, to the leading consulting (waterworks) engineers, and to the principal pipefounders in this country.

Replies to the number of 119 have been received, only 2 of them being unqualified disapprovals.

The general result of the preliminary enquiry being, beyond question, favorable to further action, the question was brought forward to the annual general meeting of the Association. The prin-

cipal points raised by the committee were as under :—

1. That varying standards should be adopted for varying pressures.

In our opinion, there can be no doubt that this is essential if the standards are to be rendered capable of general application, but it is also evident that if manufacturers are to be expected to stock the standard pipes to any practical extent, the number of standards for each size of pipe must be kept as low as is reasonably possible.

2. That the standards should be limited to the smaller diameters, as, for example, those under 16 in.

This point is one which requires careful consideration, but, in our opinion, it will depend very largely upon the relative quantities of each size of pipe required annually in the course of ordinary waterworks practice. It would evidently be unnecessary and absurd to include large diameters, which are only required by some five or six undertakings throughout the country, and in which the conditions as regards water pressure, length of main, nature of soil, and amount of traffic over the line of the mains would vary considerably in each case.

3. That standardisation should extend to water fittingts rules and regulations, pipe flanges, specials, and coating of pipes.

On this head we would remark that the questions of water fittings, and of rules and regulations to prevent waste, are being dealt with by others. In any case, however, we think that these questions would be better dealt with independently of that of cast-iron pipes. The standardisation of pipe flanges has already been taken in hand by the Institution of Mechanical Engineers.

The standardisation of special pipe castings is, of course, closely allied to that of cast-iron pipes generally. There appear to be many points common to all classes of cast-iron pipes (as well as to all classes of pipe foundries) which might with advantage be incorporated in any scheme of standardisation, but each would require to be considered on its merits.

4. That in any scheme of standardisation metric measures of weight and dimensions should be adopted.

We are hardly prepared at the present time to give a final opinion on this point, but, judging from results of previous attempts to alter our notional standards, we have little doubt that this

suggestion will have to be abandoned as impossible, at any rate for the present.

5. That standards for any given size of pipe should be based upon external diameter rather than internal.

We think it worth while to mention this point as, although to some extent a matter of detail, it is at the same time a question of such importance as to amply warrant a full and ample discussion. It offers the important advantage of rendering all spigots and sockets for a given *size* of pipe common to all *classes* of pipe under the different standards of strength, and, further, enables the pattern for any given size of pipe to be used in common for all classes, the variations in thickness being restricted to the core. The chief disadvantage appears to be the fact that the internal diameter would no longer be an accurate gauge of the size of the pipe, but that thin pipe would be slightly larger than the nominal diameter, and thick pipes slightly smaller.

It must, of course, be obvious that no attempt at standardisation could be successful unless it had the sanction and support both of the leading waterworks engineers and the principal pipefounders. The committee strongly urge that before any details are decided upon, they should be submitted to all those most intimately associated with the industry in question, and as far as possible modified to meet any views that might be expressed by them. In fact, it appears—at least, for the moment—that the most effective procedure would be either by a general conference of all engineers and manufacturers interested in the matter, or, should such a conference be impracticable, by some form of *plebiscite*.

DISCUSSION ON "INCREASING FOUNDRY PRODUCTION."

The American Machinist, Aug. 14, 1902, in an editorial, has this to say on the subject under the title "Molders for Molding":—

We reprint in this issue the principal portion of another of the unusually excellent series of practical papers presented at the recent meeting of the American Foundrymen's Association. The paper briefly but clearly tells of the method adopted in a certain foundry to increase the relative and actual output, so that it could

keep up with the demands of the machine shop which it was its function to supply. The method adopted was simple and common-sensible. The molders were allowed to put in all their working hours in molding, and the hard work at both ends of the day which does not call for the molder's skill, but which it has been the traditional custom of the trade for molders to do, was relegated to unskilled hands that could do it quite as well or perhaps better, and certainly much more cheaply. The anomalous thing is that there should be an opportunity to tell such a story as this or that the practice recommended should not have been adopted in that foundry and in every other years ago. The work of shaking out the flasks and taking out the castings, of shoveling over and tempering the sand and of handling and pouring the molten metal, except in rare cases, was never legitimate work for a highly skilled molder. It not only occupied a large fraction of his valuable time, but it actually impaired his skill and reduced his efficiency for the actual molding operations. Molding work is surely hard enough work for any man, without the unnecessary addition of any portion more exhausting. We are well aware that for years there has been a breaking up of old practices in the large specialty foundries, and that there the molders have been largely emancipated, but in the general machinery and jobbing shops the old traditions and practices still largely prevail, and they cannot be too soon abolished.

While from time immemorial molders have been molders only part of each day, machinists have generally been machinists from one whistle blow to the other, so that here would seem to be no lesson for them. This is not so sure after all. There are still machinists and machinists, and much is still to be gained in rightly apportioning their work. There is work that demands the highest skill and judgment attainable, and then there is much other work that any so-called machinist can do. The grade of skill required for roughing out and that required for finishing most lathe work, for instance, is distinctly different in its exactions. Why should the best finisher, the most reliable maker of fits, waste his time, speaking comparatively, in doing the rough turning and the preliminary work? And there is not only the man but the tool to be considered. It is very desirable to have some tools that shall be as accurate and reliable as possible for the finishing operations, and it is equally desirable to have tools of strength and stiffness, with

coarse feeds for making as much chips as possible, and these characteristics can never be combined and maintained in the single tool as well as in two or more tools. There can no more be any objection to the suggested arrangement on the ground that the man who begins a job in the shop has a "right" to finish it, because, as a matter of fact, in these days very few men begin and finish a job. The general practice is to pass the work from one machine to another, and therefore also from one man to another, and we are merely suggesting the looking out for additional opportunities for this generally profitable practice.

DISCUSSION ON THE PROPOSED STANDARD SPECIFICATIONS FOR SAMPLING IRON.

Mr. Henry Souther writes as follows :—

The only point to which I take exception in the specifications is included in the last sentence of paragraph three, where the magnet is suggested as a precaution against dirty samples previous to analysis.

I experieneed a very great deal of trouble in getting samples free from sand from my clients and am obliged to repeatedly warn them and instruct them as to clean sampling. In no case have I resorted to the magnet, inasmuch as I believe its use to be a dangerous expedient. I often see small particles of iron attached to particles of sand with the iron in large enough proportions to be picked up by the magnet. Also in the case of very soft irons, graphitic carbon is present in considerable quantities and this is not picked up by the magnet. It should be, as it forms a legitimate part of the iron.

These two sources of error in connection with the use of the magnet recommended by you, are enough to condemn the use of the magnet at all. The only way to get good results is to insist on clean samples, something quite possible to obtain with a little intelligent thought while drilling the pig. As a rule a boy learns this and succeeds in getting clean samples much quicker than an ordinary man about the foundry, who does not seem to be impressed with the importance of cleanliness as much as a boy is.

[Note by the Secretary. We would like to hear from every-

one interested in the subject of standard method of sampling iron. The method proposed by the committee will come up for final adoption at the next convention and a thorough ventilation and the pointing out of defects in the specifications as drawn up is requested.]

PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

Our Association having membership in this Society, its proceedings are naturally of interest. Through the agitation of many of our members the subject of cast iron was given an unusual amount of attention as a perusal of the extracts of the proceedings printed below will show.

The Iron Trade Review, June 19th, 1902. The fifth annual meeting of the American Section of the International Association for Testing Materials was held at Hotel Traymore, Atlantic City, June 12, 13, and 14, and throughout was a very successful and profitable meeting. Its most noteworthy action, as affecting the organization itself, was the change of the name of the Association as indicated below. The attendance was the largest in the history of the organization, more than 75 persons being registered. The present membership of individuals and firms is 185. A vigorous campaign is to be prosecuted to increase this number to 1,000.

The meeting was opened Thursday by the President, Prof. H. M. Howe, who in his annual address referred to the importance and value of the society as a means for perfecting methods of manufacturing materials of construction and their use, by the exchange of ideas and experiences among the members. He spoke of the apparent differences in the practical workings of the American Section of the International Association for Testing Materials and the lines of operation of the European sections, inasmuch as the European part of the association lays more stress upon the establishment of methods of testing, while the American branch is more concerned about the standardization of methods.

The desirability of putting the American section upon a more solid basis of organization at home having become manifest, it was proposed in the opening business session and unanimously carried to change the society into a chartered organization under the name of: The American Society for Testing Materials. A constitution

and by-laws were adopted and the society assumed its new position among the technical associations of the country under very favorable auspices. The new character of the society does not at all disturb relations with the international body. The by-laws provide that any person, corporation or society can become a member of the society and of the International Association for Testing Materials simultaneously, the annual dues being $3., of which $1.50 is transmitted by the secretary to the International Association for Testing Materials.

The following officers were elected to serve during the ensuing two years :—President, Dr. C. B. Dudley, chemist Pennsylvania R. R. Co., Altoona, Pa.; Vice President, Robert W. Lesley, Philadelphia; Secretary, Edgar Marburg, professor of engineering, University of Pennsylvania, Philadelphia; Treasurer, James Christie, mechanical engineer, American Bridge Co., Philadelphia; Member Executive Committee, John McLeod, assistant to the president of the Carnegie Steel Co.

The Ethics of Testing.

The concluding paper of the second session was by P. Kreuzpointner on "The Ethics of Testing." Among other things the speaker said that "in order that the work of devising specifications and the testing of materials of construction have a reliable commercial value to both producer and consumer, we must follow faithfully the teachings of science; but in order to perform work faithfully, we must be able to command a high sense of duty and a high sense of duty means a high ethical standard. This ought to put the work of testing upon a higher plane than mere mechanical skill, and it is to be regretted that the factor of ethics receives so little recognition in estimating the commercial value of the man's work who does the testing. In work requiring purely mechanical skill, the result can be measured by rule and compass and these are tangible quantities. In testing, however, the results must be accepted in good faith and the man's integrity becomes a leading factor in the reliability of the work performed, because no one can measure or caliper the result.

"Because of this factor of ethics playing such a prominent part

in determining the commercial value of the science of testing, it is neither scientifically correct nor commercially judicious to consider the work of testing of low commercial value, to be performed by any man of average intelligence, who is willing to accept low pay. And the closer the minimum and maximum limits of the specifications are drawn, the more complicated the work and method of testing is, the more this holds good." Attention was called to the national importance of this matter, much depending on the degree of confidence our work of testing and that of devising specifications commands abroad.

A Session on Cast Iron.

Last but not least was the cast iron session of Saturday morning with a number of interesting papers giving promise that henceforth cast iron will form an integral part in the proceedings of the society. Prof. Howe was unable to present his promised "Notes on the Constitution of Cast Iron," in which he was expected to give in some detail his theory of the relation of steel and cast iron. The first paper presented was that of W. G. Scott, of Racine, Wis., chemist of the J. I. Case Threshing Machine Co. In the absence of the writer it was read in abstract by the secretary. In the concluding portion of the paper some suggestions were made concerning mixtures, from which we take the following :

"Occasionally it happens that in a given mixture or grade of iron more strength is desired, or a closer grained iron wanted, without materially changing the silicon content. This effect may be obtained by changing some of the other constituents. For ammonia cylinders, air compressors, etc., the following is given : Silicon between 1.20 and 1.60 per cent. where the castings are allowed to cool slowly or are annealed. If not annealed silicon should be between 1.60 and 1.90 per cent. Sulphur should not exceed .095 on account of hardness, but with a high total carbon it may run up to .150 per cent without detriment, although with high sulphur there is always a chance of hard iron and excessive shrinkage, especially in low silicon mixtures. Phosphorus should be kept below 0.70 per cent. and if great strength is wanted should be much lower, say

0.40 per cent. Manganese should not exceed .60 per cent., except in case of high sulphur, when it may rise to .80 per cent.

"Medium iron for engine cylinders, gears, etc., may be made on the following formula: Silicon, 1.40 to 2 per cent.; 1.50 per cent. giving best results for gears and 1.60 per cent. for steam cylinders. If the castings have thin parts and have to be shaken out of the sand quite soon the silicon should be raised 10 or 20 points. Sulphur is best kept below .085, but if manganese be high (.60 or .70) the sulphur may run to .100 per cent. Phosphorus should not exceed .70 per cent. Manganese should be between .30 and .70 per cent.

"Soft iron for pulleys, small castings, etc., should have silicon between 2.20 and 2.80 per cent.; sulphur not above .085 per cent.; phosphorus may go up to 0.95 per cent. in small thin work, but where strength is wanted it would best be kept below .70 Manganese may be from .30 to .70.

The author laid down an approximate transvere strength of 2,800 pounds for hard iron, 2,500 pounds for medium iron and 2,200 pounds for soft iron. The following rules were laid down: To raise strength reduce graphite, phosphorus and silicon and increase manganese and combined carbon. To reduce shrinkage, increase silicon, graphitic carbon and phosphorus, and reduce sulphur. To prevent blow holes, reduce sulphur and increase manganese. To prevent kish, reduce graphite by increasing scrap or raising manganese.

Dr. Moldenke in the discussion following took exception to the use of the 1-inch test bar advocated by the writer for general use. The engineer should come more nearly in his test bar to the characteristics of the work he expected to use it for.

Mr. Sauveur referred to the claim of some foundrymen that cast iron was entirely different from steel. He believed a very close connection exists between the two. If you eliminate graphitic carbon from cast iron what have you left? Undoubtedly a matrix of steel, and nothing else, with cavities that were once occupied by graphitic carbon. If the cast iron was originally gray you would have a matrix of white iron. A knowledge of steel implies a knowledge of the matrix of cast iron. Suppose we want cast iron with the greatest possible tensile strength; we must use a matrix of the greatest possible tenacity. That means 1 per cent. or .9 per cent.

carbon. A second requirement of strength would be to have as little graphitic carbon as possible. Referring to the control of carbon, the speaker conceded the difficulty of doing this with cupola metal; with the air furnace it was more attainable. The value of metallographic methods in determining carbon in cast iron was pointed out.

Dr. Moldenke remarked that he had been working along the line indicated by Mr. Sauveur. In view of the fact that white iron constituted one-sixth of the foundry work of the country—about 600,000 tons out of a probable total of 3,600,000 tons, and a very large part of the 600,000 tons being chilled work—he believed the metallographic method in connection with chilled castings might become quite important.

Dr. Dudley recounted some of his experiences in the car wheel work of the Pennsylvania Railroad at Altoona. Whenever a new iron was brought to their attention for car wheel work the makers were asked to send several pigs. The iron was cut up into test bars in the pig and broken; then analyses were taken; and finally a piece was sent to the foundry for remelting. The laboratory after making the analysis sent the iron to the foundry with a prediction as to the depth of chill. The foundry had frequent occasion to note the failure of the predictions. The car wheel mixture used at Altoona runs 3.25 to 3.60 in total carbon, about .75 in silicon, .50 in manganese, .50 in phosphorus and in sulphur .13 to .15 now as against .08 formerly. The total carbon is lowered by adding to the mixture from 5 to 10 per cent. of steel rails. The chemical analysis hit the character of the resultant casting quite closely as a rule, but sometimes did not. The speaker found that there was something in cast iron of which little was known as yet, that had a great influence on chill. He questioned if oxygen had much to do with it. Why two irons of identical analysis would not chill alike was still unexplained.

Dr. Moldenke referred to some experience in malleable work presenting similar difficulties. He had taken iron from various stages in open-hearth heats, over the time required for a 12- to 15-ton heat, and noted the differences in the castings. He made two castings of a shape indicated on the blackboard, one end being a cube of 2-inch section, from which the width of the bar was stepped down by ¼-inch diminutions. The hottest iron, taken from the surface of the bath, was used for one of these castings and the cold-

est for the other. Of the two cubes at the large end of these castings the one poured from hot metal was stronger, and showed considerable chill, while the other was gray. He had found that low silicon iron melted much more quickly than gray or high-silicon iron. Mr. West detailed results of his experiments with hard and gray irons, showing that the former fused first. He found also that metal poured hot chilled most deeply.

The Present Status of Testing Cast Iron.

Dr. Richard Moldenke, secretary of the American Foundrymen's Association, read the following paper:

The following is summarized from conditions in America, as found in current specifications, in the technical literature, and through interchange of thought with the men identified with the testing of cast iron; then again, through discussion with notable men in Europe engaged in similar lines of investigation.

Tests of cast iron are carried out in two ways: By means of a supposedly representative bar, and by testing to destruction. The latter way is the preferable one, provided that it is fair to both consumer and producer. Our car wheel and coupler tests come under this heading, and the testing of pipe will form the text of a special communication to us today by one of our members. Tests to destruction in other lines will follow as fast as the consumer is in position to demand them.

It is, however, universally recgnized that this system of testing is applicable only to a limited range of castings, and that other methods must be adopted to assure us of good results for the general run of the foundry product. This has always been attempted by means of a test bar, with what chances of success remains to be seen. The tendencies were two-fold: First, the short coupon attached to the casting, into which coupon the iron might or might not enter under conditions identical with those of all parts of the casting. Usually the chances were against even a fair representation, and this form of testing is deservedly looked upon with less favor than formerly by those who understand something of the characteristics of cast iron. The second method was to use very long bars (often 5 feet) and test them transversely by the gradual application of a stated load. The bars gave results depending upon the manner and time taken in loading, and are now known to be

altogether too favorable to the founder. Moreover, the conditions of the test were exactly opposite to those met with in practice. An impact test would have been more suitable.

We have, however, today exectly this style of bar in use in Germany. About 3 feet long, square, and of pretty small cross section, the bar is broken transverseely, and tensile test specimens cut from the broken pieces. On the other hand our German friends are desirous to have further light on the subject, and have appointed a commission to study the matter thoroughly. They further compliment us by utilizing our results in their investigations. The German specifications for pipe will no doubt be touched upon by another of our speakers today, for herein they have been active in the Fatherland.

Many have been the tests made on bars, and each line of investigation has had the benefit of at least some previous recorded experience. The result has been the crystalization of ideas, which has probably found as good an expression as any in the recent report of the committe appointed by the American Foundrymen's Association, wherein short, heavy round test bars, and these cast on end, are recommended.

There is, however, another idea embodied in the report just alluded to, and this is so different from those generally accepted that it must be mentioned here. Our American founders, who know the material they are producing daily at least to some extent, recognize the fact that even with the best of iron, a casting may be of inferior quality through improper conditions existing at the time of pouring, and this unknown to the average layman. They further know that a weak of unsuitable iron can be strengthened artificially, when making test bars, so that it may pass muster, and yet the casting may be inferior. For these reasons, therefor, in adopting the specificationg they did, our American foundrymen cut loose from the very laudable, but entirely impossible production of test bars which are held to be identical with the casting, and selected a method which would give as nearly as true valuation of the quality of iron going into the casting as possible. If afterwards a casting could be tested to destruction, so much the better. The fact that the iron which goes into a casting is found to be of suitable quality, and of sufficient strength, is the only safe-guard which can really be expected from the test bar anyhow. This presupposes that the

iron is cast into bars under conditions as fair as possible in the light of our present knowledge: that the bars of the size and shape which will neutralize as much as possible the variations due to the sand, the pouring temperature, and the pouring method, and that no artificial strength, or avoidable weakness be tolerated. By making such tests regularly, a founder can quickly satisfy himself, and possibly his customers, on the score of "quality' so far as the iron poured into the castings is concerned. Even tests to destruction are not always as satisfying.

The present status of the question under discussion seems to indicate that the subject hinges upon whether producers will open their works to customers, and give them every facility to judge for themselves the quality of the iron made by means of the tests just spoken of; and on the other hand, whether customers will accept this as a guarantee of good faith, and the desire to give them the best work that can be made. The customer, it may be added, quickly becomes a competent judge of the good or bad conditions prevailing in the various foundries from which he draws his castings when in contact and direct touch with them.

Foundry Experience Needed for Proper Inspection and Testing of Cast Iron.

Thomas D. West, of Sharpsville, Pa., read a brief paper on the above subject. He said that a compilation of all methods now used for testing the physical properties of cast iron would result in such a variety as to bewilder one not broadly experienced in the different branches of founding. "Of all metals, cast iron is the most complex in its physical structure. This is because of the fact that changes in the rate of cooling like grades of iron and cross sections produce radically different crystalline fracture or grain in the iron. Two pieces of the same cross section and poured from the same ladle of iron, can, by difference in the rate of cooling, be made entirely different in physical structure, one having a soft or open grain, and the other a hard dense grain, or chilled. Again, by uniform section and constant rate of cooling, but varying the silicon, sulphur, manganese and phosphorus, we can produce different grades, varying in degrees from a very soft, open-grained iron to hard or chilled iron.

"Where inspection of appearances, as to smoothness and beauty of finish only is required, or where work is duplicate, as in

the case of car wheels, and subjected to certain prescribed tests that have proved proficient by numerous trials, then lack of foundry experience in the inspector may not be of vital importance. Where the inspection of castings is for the strength, solidity or durability, in castings that cannot be tested by breaking a duplicate, it is rare that the possession of foundry experience cannot prove of value, as the test bar, or any other special method of testing may often fail utterly in ascertaining the true character of a casting. For example, when castings like rolls, punch and shears, or flywheels, of which there are many, break from usage and the fracture exhibits shrink holes or a very porous grain compared with other sections, wherein has the test bar or chemical analysis proved of value, in showing a strong iron or apparent solidity? In connection with the test bar and chemical analysis, the experience of broad founding can, in almost all cases, be well combined in passing judgment upon the durability of these castings. Foundry experience cannot give an inspector an X-ray eye with which to see the interior of castings, but to a certain extent it will aid in determining what may be expected, judging from methods used in pouring and feeding to supply the shrinkage of the parts that might be weak from porosity or shrink holes. There may be cases where an inspector experienced in broad founding can fortify his position by seeing a mold before it is closed, and being upon the ground at the time of pouring and feeding a casting, as it is not uncommon to have a mold provided with proper feeding heads and pouring gates, and yet the feeding be such as not to produce a solid casting.

"Aside from shrink holes, blow holes occur, and it requires foundry experience to judge of their existence. There are certain lines of castings that may have blow holes, while others have not. It generally requires some experience to define a shrink hole from a blow hole, and one can be as injurious as the other. As with a shrink hole, the blow hole may often be best predicted by seeing the methods of molding and casting, and the broader the experience of the foundry inspector the better, in passing judgment upon the solidity or strength of such castings.

"Next in order, is to judge of the evils of contraction. When castings are of disproportionate sections, one part will contract more than another, so as to leave an internal strain that no test bar records can properly indicate. Such strain may be greatly overcome

by methods of cooling after a casting has been poured. Experience in founding enables an inspector to determine at what points weakness may exist or where to detect slight cracks.

"Sufficient has been outlined to illustrate that there is much beside test bar records needed to pass upon the durability of a casting. Nevertheless, the test bar has often a very important function. Again, in designing form and size and the method of molding and casting test bars, a broad experience in founding is essential. The want of this experience has resulted in methods being advocated that have caused much contention and confusion of ideas and retarded the establishment of what are truly practical systems for testing.

"High Strength of White Iron Castings as Influenced by Heat Treatment."

A. E. Outerbridge, Jr., of Philadelphia, read a paper detailing an experience in car wheel work in 1882, and the conclusions he had drawn from it as to the characteristics of what is termed "converted white iron." In the annealing of a number of car wheels, the dampers of the furnace had been left open by accident and the flames had infringed upon the treads of several wheels, producing soft spots. It was found that the white iron of the chilled portion had been changed to gray iron in spots, the white and gray portions of the tread being in general distinctly marked. The phenomenon was due, he concluded, to the change of some of the combined carbon to the free condition under the action of the flame. The speaker passed from this experience to a discussion of the so-called processes for the conversion of white iron into steel, which were announced now and then Though sometimes the use of a secret chemical compound was a part of these processes, which converted cast iron axes, hatchet blades, etc., into so-called steel, the speaker considered it demonstrated that heat treatment alone was relied upon for the change. These products he considered to be not steel castings, though so sold, nor malleable iron, since none of the carbon was removed, but midway between the two. The paper discussed at length the changes in the carbon in cast iron under heat treatment and the important influence exerted by silicon. We expect to present it in full in a later isiue.

The discussion, which was participated in by Messrs. Sauveur,

Moldenke and Stanley G. Flagg, Jr., brought out dissent from Mr. Outerbridge's view that the process of converting white iron into gray differed substantially from ordinary malleable methods. It was pointed out that while castings which were to be converted into malleable were embedded in an oxidizing material for the removal of some of the carbon, the malleable methods af today also included annealing without the use of an oxidizing compound. The operation here consisted rather in breaking up combined carbon under the heat treatment, rather than the removal of carbon. Mr. Flagg referred to the use of brick dust, lime and other substances in this way, and to annealing with oil as now practiced by some manufacturers.

Specifications for Cast Iron Pipe.

Walter Wood, of Philadelphia, presented a discussion of "Current Specifications for Cast Iron Pipe." He said that the subject of specifications was now under discussion between water works engineers and manufacturers, with the expectation that final results would shortly be reached. It was also hoped that foreign manufacturers would agree to these specifications and thus make them international. In testing work connected with cast iron pipe founding, practice had changed from the 1-inch round bar to the 2x1-inch bar, 24 inches between supports, the required breaking strain being 1,800 to 2,059 pounds. Iron most suitable for cast iron pipe should range in phosphorus from .5 to 1 per cent.; manganese about the same range, though .75 to 1 per cent. is more desirable; silicon, from 1.25 per cent. for large pipe and 2.25 for lighter pipe. Sulphur is not wanted. Phosphorus is desirable on account of the shrinkage, though sometimes such a shrinkage is found as will pull off the bead of the pipe.

A Contraction Test for Metals.

The paper of Asa W. Whitney on "A Quick Foundry Contraction Test for Metals" went at length into a subject with which the writer is thoroughly familiar. We reserve more detailed account for a later issue. Mr. Whitney illustrated by a diagram a device he had developed to make the contact of the test piece with the chiller continuous and to indicate automatically the progress and extent of contraction of the larger diameter of a frustum of a

cone. While not exhibiting any samples cast in the style of test mold he suggested, Mr. Whitney showed some photo-micrographs indicating in general what chill is and how much more fully metallography can define it than chemistry alone.

The discussion of the cast-iron papers was interesting and spirited throughout and brought out much valuable material. The suggestion of the relation of steel to cast-iron, which it was expected would be developed iu the paper of Prof. H. M. Howe, is especially important as furnishing the probable keynote of cast-iron investigations in the immediate future.

The members and guests present at the meeting could not but be impressed with the strong spirit of harmony and cordiality which pervaded the discussions, and which augurs the continued co-operation of all interested in the important work of the society. The secretary, Prof. Marburg, worked untiringly to make the meeting successful, and great credit is due all who had part in the arrangement of so valuable and varied a program.

PROCEEDINGS OF THE ST. LOUIS FOUNDRYMEN'S ASSOCIATION.

The Age of Steel, Aug. 4, 1902. The annual meeting of the St. Louis Foundrymen's Association was held on Friday, August 1st, in Parlor B of the Planters' Hotel. The meeting was largely attended and the reports of the officers were read and showed the Association to be in excellent condition.

Mr. Ferd. Schwedtman, president of the Magnetite Foundry Company, was elected president for the ensuing year. Mr. Wm. Medart, secretary of the Medart Patent Pulley Company, was elected secretary and treasurer. The other members of the board of directors elected were Messrs. W. S. Simpson, president of the Christopher & Simpson Architectural Iron Company; Mr. George F. Cottrill, vice-president Green's Car Wheel Manufacturing Co., and J. C. Davis, manager of works for the Leighton & Howard Iron and Steel Company.

The association is in a prosperous condition, and with a new policy which is to be inaugurated, it is thought that every foundry in St. Louis will soon be identified with this association. The chief object of the association is to amicably settle all differences with labor that may arise in the shops of any of the members, arbi-

tration being the fundamental principal of the organization. The association has headquarters established in room 613 Century Building, where Mr. Earle Layman, the assistant secretary, keeps the members advised and looks after the details of the work.

PROCEEDINGS OF THE FOUNDRYMEN'S ASSOCIATION OF PHILADELPHIA.

The Iron Trade Review, March 13, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, March 5, the president, Thos. I. Rankin, occupying the chair. Notwithstanding the inclement weather there was a fair attendance.

The question of the incorporation of the association came up for discussion, but the matter was deferred pending the amendment of the constitution in order to make the step possible.

M. J. Drummond & Co., 192 Corbin building, Broadway, New York, were elected to membership in the association.

The paper of the evening was presented by Howard Evans, of the J. W. Paxson Co., Philadelphia, the popular secretary of the association, on "The Charlier Oil Fuel Brass Furnace." The paper fully covered the points in the construction and operation of this furnace, as set forth in the article appearing in our issue of February 27. Supplementary to the paper were presented lantern slides showing the furnace and a rig for phosphorizing metals, the furnace during the act of pouring, and the pump rig for supplying the oil fuel. Slides were also shown of the Schwartz melting furnace for brass foundries, and a furnace made in England for use with crucibles. The phosphorization of metals in the furnace was fully explained. The phosphorizer, with a weight on it, was seen to be suspended from an overhead pulley attachment, so that the churning of the metal could be easily and thoroughly done.

APRIL 10, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, April 2, the president, Thos. I. Rankin, occupying the chair.

The first business taken up was that of incorporating the association. P. D. Wanner, in support of the idea, detailed certain changes in the constitution and by-laws, which would have to be

made before application could be made for a charter. He then moved, and the motion was seconded by Howard Evans, that the changes suggested be made and adopted.

The election of trustees followed, secretary Evans placing in nomination John E. Harbster, of the Reading Hardware Co.; Charles S. Prizer, of the Prizer-Painter Stove & Heating Co.. and P. D. Warner, all of Reading, Pa., from which place application for the charter is to be made. They were unanimously elected.

The paper of the evening was by Charles Kirchhoff, editor of THE IRON AGE, New York, and dealt with "Trusts and Their Effect on the Business World." The paper, which was not filed for record, was very interesting to all present, The author took the standpoint that in general the consolidations, or so-called "trusts" had proved beneficial to the trade at large, particularly the jobbing trade, and many evils existing in the trade had been corrected. At the conclusion of the reading of the paper, which was quite lengthy, a vote of thanks was extended to Mr. Kirchhoff.

MAY 15, 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on Wednesday, May 7, the president, Thos. I. Rankin, occupying the chair. There was an attendance of 35 members and visitors. Secretary Howard Evans announced that the steps for the incorporation of the Association had advanced to the point of applying for a charter.

After the adjournment of the meeting the members reassembled in the cafe where the usual luncheon was served and speechmaking was indulged in to a late hour.

The address of the evening was by E. H. Mumford, who spoke of the application of the Tabor vibrator molding machine to large work. Lantern slides were used in illustration. The speaker said that while the Tabor company built probably larger power ramming molding machines for general use and had still larger machines in prospect than were as yet common in the trade, the idea that machine molding was at once to be applied to such castings as loam cylinders with blanket cores, 30-ton bed plates, etc., was more or less visionary.

Molding machines, he said, were variously understood by the trade. Some were called molding machines which only rammed the mold; others which only drew the patterns, and yet many ma-

chines did both. Mr. Mumford then showed on the screen a power ramming machine for molds of large size which was simply a big power squeezer. He next showed a large sized hand ramming molding machine with 10-inch pattern draft which only drew the patterns. There was then shown a complete machine for both power ramming and drawing the patterns for molds 30x48 inches, the machine having 12-inch pattern draft. He explained that in this large machine, while the deeper pockets of sand around the pattern had to be more or less tucked by hand, yet the main body of the sand in a flask each half of which is 16 inches deep was rammed by the machine itself, and showed how the entire working of the machine was carried out from one station by the operation of two valves.

The Tabor molding machines as built today do their ramming by a quick blow. The speaker thought this method of ramming had some advantages over the slow pressure inasmuch as it took advantage of the fact that the loose sand contained air which more or less livened up the sand when the blow was put upon it quickly.

The hand ramming machine which was shown was explained to be useful especially for such deep work as couplers, oil boxes for cars, etc., and details of the machine were shown illustrating the application of various forms of stripping plates to such patterns as require stripping.

The 30x48-inch complete machine which was shown on the screen in detail and in general elevation, Mr. Mumford said began work on castings of the nature of covers for journal bearings, having dry and chambered cores and weighing 1,000 pounds each. The output on this machine, he stated, was 12 molds, or 12,000 pounds from a molder and helper. In connection with the work on this machine it was explained that wooden stripping plates were used on some of it, the stripping plates in some cases being clamped to flasks when lifted from the machine and returned to the machine afterward. The stripping plate and the vibrator were often used simultaneously, and sometimes one sometimes the other. The use of the wooden stripping plates clamped to the flasks and lifted from a machine with them, Mr. Clark at Schenectady has found to save the necessity of bars in the flasks on this large work. To make possible the use of such stripping plates no change in the machine is necessary, the stripping plate covering the flask frame and pattern

plate together, and on hand ramming machines for such work as oil boxes, sheet brass stripping plates about 3-16-inch thick are successfully employed. The speaker said that he had stripped 5x9-inch oil boxes on one of the Tabor machines with a sheet of ordinary roofing tin made into a stripping plate for the work in an hour.

The discussion which followed the address developed the interest which all foundrymen have in knowing how far machine ramming can go on large work and Mr. Mumford made it very clear that no builder of power ramming machines would pretend today that close spaces between flasks and patterns or deep pockets in the pattern surface, such, for instance, as the pocket in a grate bar could be rammed by power. This would be possible if sand could be treated as a fluid, but it cannot, as it moves very little out of the direct line of pressure and its friction on itself and its surroundings is very great.

Asked to forecast the future as to the size of work on which molding machines would be used, the speaker stated that his company was at the moment building a power ramming and pattern drawing machine to handle flasks 28x70 inches, the two power ramming elements of which each weighed 20,000 pound, to produce castings weighing from 900 to 1,200 pounds each, and that he saw no reason why the radically new principle involved in this machine should not be applied to castings molded in flasks and weighing 10,000 pounds.

JUNE 12, 1902. The 119th meeting of the Foundrymen's Association was held in the Manufacturers' Club, in Philadelphia, on Wednesday evening, June 4, with a good attendance of members. The president, Thos. R. Rankin, occupied the chair.

The Secretary read an invitation from the Secretary of the American Foundrymen's Association, Dr. Richard Moldenke, inviting the members of the Philadelphia organization to the Boston Convention, June 17- 19.

Mr. P. D. Wanner presented the papers covering the granting of the charter of incorporation of the Association.

Mr. J. Wesley Pullman, of Philadelphia, was a candidate for membership, and by a unanimous vote was elected.

A letter was read from Mr. Antonia C. Pessano, of the Geo. V. Cresson Co., Philadelphia, and chairman of the Executive Committee of the Association, resigning his office. This action was

due to his removal from Philadelphia to become president and general manager of the Great Lakes Engineering Co., Detroit. Mr. Pessano's resignation was accepted with regret. Mr. J. S. Stirling referred to the great interest Mr. Pessano had always taken in the Association's affairs and said that the resignation could not be accepted without comment. He therefore moved that a committee of three be appointed to prepare a suitable resolution conveying the regret of the Association that so valuable an officer should be lost to them, and the best wishes of the Association for his success in his new field. Messrs. Stirling, Wanner and Devlin, were appointed such a committee, and later presented the resolution which was passed and ordered to be engrossed and forwarded to Mr. Pessano.

Mr. P. D. Wanner then read a paper on "How many hours shall constitute a day's work," after which Mr. A. G. Warren spoke on the "Paxson-Warren Sand Blast System," both of the papers being discussed.

The meeting then adjourned for the summer.

PROCEEDINGS OF THE GERMAN FOUNDRYMEN'S ASSOCIATION, DUESSELDORF, JULY 10-12.

Many of our American foundrymen have made a special trip to Duesseldorf to visit the Exposition there. This is especially rich in the products of iron and steel. There was little wonder therefore that the German Foundrymen's Association met in convention there, where the auspices are so favorable. The fact alone that here were exhibited the results of the most skillful manipulation of the foundry product, by firms which are the strongest competitors indicated the necessity for a close union on the part of foundrymen, in order that progress might be as general as possible, and that the individual would not be at so great a disadvantage in the open market. It is stated that this feeling was generally expressed by those in attendance, a feeling with which we in America may well reckon.

The first topic under consideration was the condition of the market. In spite of the diversity of opinion, it was clearly shown that the conditions in Germany in the foundry trade were not so desperate as is generally supposed. Inquiries were becoming more

plentiful, and if prices were not good, the founder had himself to blame.

On the other hand there was still much to be desired in the market, and the financing of building enterprises was not as it should be as yet. Strange to say there was much bitterness expressed in regard to the undue competition of blast furnaces also engaged in the foundry business. Over here the foundry trade would not take very kindly to a furnace making other peoples' castings. They seem to have this on the other side though.

The loss of business through substitution of wrought iron columns for those of cast iron came in for a share of the convention's time, and it was recommended that special efforts be made to show the undoubted advantages of cast iron columns over the others to the building trades. While we would be a little dubious on this point over here, yet we must praise our German foundry friends for their aggressiveness and the determination not to let business slip by without making a strong effort to hold it. The same was done for the steel castings, which is also making heavy inroads in the foundry trade in Europe. Greater efforts to produce better grades of castings were recommended. This applies to us very pointedly also.

Secretary Scherenberg now read his report, which was adopted without comment. Mr. Kohlschuetter reported on the question of damages for breakage in Railway transit. The attempt to gather statistics of production during the year proved to be unsuccessful. It was pointed out that this circumstance was to be regretted, as good and full statistics are of great value in guarding against undue fluctuations in buying and selling prices, as well as keeping the pulse of the industry normal.

Similarly the sending out of regular market reports was not taken to kindly by the Association, and the work was deemed somewhat outside of the functions of the Association. This is correct as the great Iron Journals are in much better position to give reliable market reports than an association composed of one class of men in the general industry only.

The sum of 3,000 Mark was expended by the Association in the study of foundry conditions. Prof. Wuest had made a number of experiments in connection with the cupola process. The programme for the coming year is to be an investigation of American

versus German cast irons. The effect of basic versus acid linings of the cupola and furnace. The sulphur contents of coke, etc. It would seem then that our German friends are doing vastly more for their industry than we are. The sum mentioned represents much original work, and it would be well for our Association to look into the advisability of following in their footsteps in this regard.

The culmination of interest was reached in the discussion of the Trusts, of which the foundry trade has two. The Pig Iron syndicate and that for coke. Heavy artillery was brought to bear on these octopi, but they were defended with no less vigor. It was shown that there were some things to correct, and the Association appointed a committee to take the several questions up with the trusts for adjudication.

Privily Councillor Juengst, who has done so much to bring about standard methods for testing cast iron in Germany, was made an honorary member (the first one) of the Association.

Kassel was selected as the next meeting place, and the Convention closed with the usual banquet.

Several valuable papers were read, during the special business sessions, and these will be reviewed at another time.

Journal of the American Foundrymen's Association.

VOL. XI. DECEMBER, 1902. PART II.

PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The Iron Trade Review, Oct. 9, 1902. The annual meeting of the Pittsburg Foundrymen's Association was held at the rooms of the Engineers' Society of Western Pennsylvania, Pittsburg, on Monday evening, Oct. 6. Officers for the ensuing year were elected as follows: President, B. J. Thomas, of the Sterrit-Thomas Foundry Co.; vice president, A. V. Slocum, of the Keystone Car Wheel Co.; treasurer, Philip Mathes, of the Britten-Mathes Co.; secretary, F. H. Zimmers, of the Union Foundry & Machine Co. The executive commitee consists of the following members; Wm. Yagle, John McClaren, B. D. Fuller, E. A. Kebler and J. S. McCormick.

Methods of making the meetings of more value to the foundrymen were discussed at length, and it was decided to appoint a program committee whose duty it will be to provide topics for discussion and papers for all the meetings. A committee of five was appointed consisting of A. O. Backert, chairman; A. V. Slocum, S. H. Stupakoff and the president and secretary as ex-officio members. The secretary was also instructed to secure the names of all the heads of departments of the foundries in the Pittsburg district for the purpose of urging them to attend the monthly meetings regardless of their membership. The foundrymen will be urged to secure the attendance of the heads of their departments and every effort will be made to secure a better representation of the foundrymen at these meetings. After the meeting adjourned, lunch was served.

Nov. 6th. At the regular monthly meeting of the Pittsburg Foundrymen's Association, held at the rooms of the Engineer's Society of Western Pennsylvania on Monday evening, Nov. 3, the subject under discussion was "Coke". Inasmuch as this product is causing foundrymen much annoyance at the present time the subject was generally discussed by both the foundrymen and coke agents. Interesting papers on the subject were also presented by N. P. Hyndman, of the Washington Coal & Coke Co., and Charles H. Stroh,

of the American Locomotive Works, while S. D. Sleeth, of the Westinghouse Air Brake Co., talked interestingly.

Mr. Sleeth spoke briefly of his experiences with cokes high in sulphur, and said that they had produced coft castings successfully with coke running as high as 1.65 and 1.71 in sulphur, despite the fact that most foundrymen insist on holding their sulphur down to .65 and .75. He said that his success with this high sulphur coke no doubt was due to the large amount of limestone used in the flux, which took up the greater portion of the objectionable sulphur. He further cited an experience with light coke which is out of the ordinary. It ran as high as 88 in fixed carbon, 10 and 11 in ash and about .85 in sulphur, and did not require as much coke in weight, the bulk being the same, to produce a given amount of castings as the heavier coke. Analyses of coke taken from the bottom, center and top of the ovens, showed very little difference, although it is the general impression among the trade that coke taken from the center is much more desirable than coke taken either from the top or bottom.

The question of 72-hour coke was discussed at length. Mr. Howard Hooker, of Rogers, Brown & Co., stated that it is an absolute necessity, owing to labor conditions, for the coke manufactures to produce this kind of coke over Sunday, and it was suggested that possibly this was considered the best coke on account of the conscientious scruples of the coke workers in refusing to draw the ovens on Sunday, which is the case in the Connelsville region. The discussion waxed warm, and none of the foundrymen present were absolutely certain that they could recognize 72-hour coke although insisting on its delivery for their foundry use. G. P. Maury, of the Metallurgical Laboratory, stated that he attempted to secure a sample of 72-hour coke for the purpose of making an analyses of the same, but found it almost impossible to secure it for the reason that none of the foundrymen in Pittsburg were certain that they had any on hand.

One of the foundrymen stated that a large stove foundry in Detroit is using by-product coke to good advantage, despite its dark appearance and structure. Some of the foundrymen stated that they had attempted to use this coke, but were not successful and had never repeated the experiment. It was stated, however, that there was a possibility that this kind of coke will be used more exten-

sively for foundry work in the future, prejudice now militating against it.

The program committee reported a list of topics that will be discussed throughout the season 1902-1903 as follows.

December—"Facings—Sea Coal, Plumbago, Soap Stone and General Facings." January—"Fan Blowers." February—"Gates and Sprues." March—"Molding Sand." April—"Cores." May—Banquet or smoker. June—Held open.

PROCEEDINGS OF THE FOUNDRYMEN'S ASSOCIATION OF PHILADELPHIA.

The Iron Trade Review, Oct. 9 1902. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, Oct. 1, the president, Thomas I. Rankin, occupying the chair.

The treasurer, Josiah Thompson, reported a balance in the treasury of $3,070, and all bills paid.

The Manufacturing Co. of Carlisle, Carlisle, Pa., was elected to membership in the association.

According to the constitution of the association, nominations for officers for the ensuing year were in order, but it was deemed advisable to leave the matter in the hands of a comittee, therefore on motion the president appointed S. L. Moore, Josiah Thompson, and George C. Davis as a nominating comittee to report at the next meeting, and at this meeting the election also will be held.

The paper of the evening was by J. H. Pepper, editor of the *Brass Founder and Finisher*, Philadelphia, on "A New Kiln and Furnace; and its Possible Adoption in the Annealing of Malleable Castings." The paper was illustrated by lantern slides.

After adjournment the usual lunch was served.

The Iron Age, Nov. 13, 1902. The eleventh annual, being also the one hundred and twenty-second regular, meeting of the Philadelyhia Foundrymen's Association, was held at the Manufacturers' Club in that city on Wednesday evening, November 7. The president, Thomas I. Rankin, occupying the chair, called the meeting to order at the usual hour. There was a large and representative attendance.

The reading of the minutes of the previous meeting was dispensed

with in the usual manner. The treasurer reported a balance on hand amounting to $2075.82 with all bills paid.

The Committee on Nominations of Officers of the association for the ensuing year reported as follows: President, Thomas Devlin of Thomas Devlin & Co., Philadelphia; vice-president, James S. Stirling, Harlan & Hollingsworth Company, Wilmington, Del.; treasurer, Josiah Thompson of J. Thompson & Co., Philadelphia; trustees, D. G. Moore of S. L. Moore & Sons Co., Elizabethport, N. J.; Thomas Enyon of Enyon & Evans Mfg. Company, Philadelphia; Dr. E. E. Brown of E. E. Brown & Co., Philadelphia, R. C. Oliphant, Trenton Malleable Iron Company, Trenton, N. J., and William Hanson, Pennsylvania Iron Works Company, Philadelphia. There being no other nominations, the secretary was ordered by vote of the association to cast a favorable ballot for all the officers, and they were duly elected.

The papers of the evening followed. H. O. Evans read a paper on "The Study of the Cupola," by Arch. M. Loudon, New York (published in the *Journal* of the American Foundrymen's Association, October, 1902), and an abstract from the *Journal* of the American Foundrymen's Association, September, 1902, on the "Discussion of the Melting Ratio in Cupola Practice," was read by James S. Stirling. Considerable discussion followed and various results as to the ratio of iron and fuel in the cupola were mentioned.

D. G. Moore of S. I. Moore & Sons Company said that the question had interested them particularly some time ago and resulted in a careful 60-day test, in which iron and coke were weighed daily, no deductions being made for the scrap or coke remaining after the heat was run. The cupola used was an oval type, 30 x 60 inches. The mixture was two-thirds pig iron and one-third scrap, the total heat 25 tons, and 72-hour foundry coke was used. The result obtained varied as to the temperature of the metal. With good hot iron for machinery castings, 9 to 1 was the average, in some cases 10 to 1 was obtained, and even 11 and 12 to 1. In the last, however, the iron was cold and figures therefore were of no value. In this practice the best results were obtained at an average ratio of about 9 to 1. They prefer the practice of operating two smaller cupolas to one large one, running each hot right up to the end of the heat. In their heats of 25 tons they frequently take four grades of iron from the cupola—soft, hard, chilled and steel mixed

—in which cases more fuel is required owing to the blank or parting charge of coke, and ratio in each case becomes lower.

Mr. Rankin of the Abram Cox Stove Company said that in their foundry, where there was a very large amount of light work, castings one-tenth and one-twelfth inch in thickness, and up to 38 inches square, it was absolutely necessary to have hot iron. They could not obtain a better ratio than 7 or 6.8 to 1 with good coke.

Dr. E. E. Brown said that the question of the ratio of coke and iron had been discussed by them for some time, and he believed they were getting as good results as many others. "Ordinarily truthful men are apt to forget" in discussing these figuras at times and it is difficult to reach any definite conclusions, besides the conditions existing so alter the cases that comparisions are worthless.

James S. Stirling, W. H. Ridgway, H. O. Evans, S. G. Flagg, Jr., and T. C. Price, also tookpart in the discussion, bringing out the question of the number of charging doors best suited for the cupola, their heights and sizes and distances from the charging floor, pressure of the blast, &c. These various points are at considerable variance and subject to the conditions, surroundings and nature of the work to be done in each individual case.

After adjournment the members and their friends proceeded to the roof garden of the club, where the usual luncheon was served.

PROCEEDINGS OF THE NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

The Iron Trade Review, Nov. 13. The November meeting of the New England Foundrymen's Association was appointed for Wednesday, Nov. 12, at 4 p. m., at the Hotel Essex, Boston. The foundrymen of Boston and points within 100 miles of that city make these meetings semi-social in character, the plan being to discuss topics of interests to the members, take dinner together and continue the discussion after dinner. The speaker for this week was E. H. Mumford, of the Tabor Mfg. Co., Philadelphia, and his subject, "The Molding Machine and Its Relation to Foundry Labor." For the December meeting, on Dec. 10, the speaker is James H. L. Coon, State insurance inspector, and the subject for discussion, "Insurance Inspection—Its Importance to the Manufacturer." Wm.

J. Keep is to speak at the meeting on Jan. 14 on "Calculating Foundry Mixtures by Mechanical Analysis." For the February meeting Dr. Richard Moldenke, secretary of the American Fouudrymen's Association is the speaker. At other meetings James A. Becket, of Hoosic Falls, N. Y., and J. A. Walker, of the Dixon Crucible Co., Jersey City, N. J., are announced.

In sending out the program of its fall and winter meetings the executive committee of the New England association has mailed a circular to a considerable number of non-members within easy reach of Boston and urged their attendance and their co-operation as members. The New England Foundrymen's Association is in live hands, having for its executive committee the following: John Magee, Magee Furnace Co., Chelsea. Mass.: Theodore Colvin, Colvin Foundry Co., Providence, R. I.; F. B. Farnsworth, McLagon Foundry Co., New Haven, Conn.; Wm. Doherty, Doherty Bros., owell, Mass.; Jas. F. Lanigan, Davis Foundry Co.. Lawrence, Mass.

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. APRIL, 1903. PART II.

THE METALLURGICAL SECTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

BY HERBERT E. FIELD, ANSONIA, CONN.

The various committees of the American Foundrymen's Association have heretofore taken care of the problems which have arisen in connection with the advent of metallurgy into foundry practice. Owing to the increasing demand thus placed upon the Association a separate section has been organized to take care of this branch of foundry progress. This Section is designed to act as a central exchange for ideas and to direct the advancement of metallurgy in its relation to foundry and furnace practice. Foundry chemistry and foundry metallurgy have, like all new movements, been hampered by insufficient knowledge and by misleading statements made by inexperienced writers. These writers have been without doubt sincere in their opinions, but they have, nevertheless, done immeasureable harm to the advancement of chemistry in foundry practice. They wrote at a time when little was known about the subject and whatever was said was accepted as truth and practiced as such. When the expected results were not achieved, Metallurgy was condemned while in reality it was the lack of correct knowledge for its application which was at fault.

Individual chemists have from time to time brought before foundrymen the results of experiments which have proved of great value. These results have, however, lacked the backing, which a strong Association would have given them, and often passed unnoticed, or, if noticed at all, have been classed with the mass of unreliable matter previously mentioned. This Section intends to systematically investigate debated problems and to place before the members for their use the results of these investigations in such a

manner as to warrant their acceptance or rejection as correct bases for practical work. There are new propositions continually coming up in this branch of practice which are now slowly and tediously worked out by individual metallurgists in the spare time which they have at their command. The Metallurgical Section by distributing such work and placing parts of it where it can be most conveniently carried out will be able to greatly expediate these investigations. These problems will be brought before scientific institutions whose equipment and experience in original research will enable them to make a thorough and correct solution of that side of the question. The practical work in connection with the investigations will be done by founders whose equipment is best suited to the matter unconsideration. The practical and scientific will thus be combined in a manner which has been much talked of but never accomplished.

Our technical schools are more than anxious to do their part, while foundries are expressing an increasing interest in the work. A strong organization to direct is necessary to complete the success.

Numerous problems arise in regard to iron which cannot be solved by the foundryman. They can only be worked out at the pig iron furnaces. The furnacemen, by their endeavors to find out just what compositions and characteristics are wanted by the foundryman, show that they are alive to the fact that there is much room for study and improvement in their line. The first suggestion for the formation of such a Section came from the selling end of the pig iron trade, and this Section expects to count pig iron furnaces among its strongest members.

Chemistry is to have a more useful position in furnace and foundry practice. This is plainly shown by the statement of prominent pig iron and foundry men in the recent issues of trade papers. Agitation in regard to grading, sampling and standardizing indicates the great interest now manifest in this line of work. Progress has been, and will continue to be made, whether such an association is formed to aid it or not. If, however, the labor lost by duplication can be avoided and investigations carried on under the most auspicious circumstances, much greater progress will be made and advancement will be more rapid.

The first problem brought before the Section for solution is that of standardizing methods for the analysis of iron. The ing complaint of furnacemen and founder that the analysis of

different chemists did not agree, induced the American Foundrymen's Association to refer the matter to its standardizing committee with the idea that this committee could adopt a series of standard methods for iron analyses, and thus obviate the error due to the difference in the methods used. This work has since been referred to the Metallurgical Section, and the classifying and editing of the various methods now in use is being done by its Secretary. The methods sent to the standardizing committee prove that there are many now in use in chemical laboratories which are inaccurate and unreliable. Whether this Association adopts a set of standard methods or not, it will point out as inaccurate, many methods now in use in iron work.

Many founders are having their analyses made by independent laboratories, and at the suggestion of these founders it was decided to include these laboratories in the list of those who are available for membership in this Section. They have shown a decided interest in the work and will make a valuable addition to the Association, and the Metallurgical Section will be of great practical value to them.

This Section, then, is organized for any who are engaged in the study or practice of chemistry and metallurgy of iron. There is no intention of taking the place of or interfering with the work of any other society. This is a time of specialists. We are, it is true, interested in the work of our fellow scientists in all other lines of work and would be the last to lessen in any way the great good being accomplished by our national scientific societies. There is, however, a crying need in the iron business for an association active, alive, and awake to the conditions and opportunities of the times. An association before which papers may be read? Yes! But an association which will help and educate its members in the metallurgical side of the iron business, an association which, proceeding in a thorough and systematic manner, will investigate and solve problems arising in everyday practice of metallurgy in foundry and furnace work. It is just this place that the Metallurgical Section is designed to fill, and will fill with credit to itself and to the American Foundrymen's Association, provided it is given the proper support.

The section is organized with all the prestige and support of the American Foundrymen's Association behind it. The Journal, in which all the papers and investigations of the Section, will be published, has made for itself an enviable position in the scientific

and industrial world. The American Foundrymen's Association stands as a representative of true American progress in foundry matters and its reputation is assured abroad as well as at home. The Metallurgical Section has the opportunity to share in this well earned reputation.

The essential factors for a successful organization are all present. An opportune time, an unoccupied field, an increasing demand, and a strong parent organization. The scope and usefulness of the Metallurgical Section of the American Foundrymen's Association will only be limited by the number and activity of its members.

Those who are engaged in the practice or study of any branch of the iron trade, in which metallurgy and chemistry form an important part, will be greatly benefitted by affiliating themselves with this Section of the American Foundrymen's Association.

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. APRIL, 1903. PART II.

PROCEEDINGS OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

A stately volume of some 400 pages lies before us, giving the proceedings of the fifth annual meeting held in Atlantic City, June 12, 13, 14, 1902. It is edited by the Secretary, Prof. Edgar Marburg, of the University of Pennsylvania, and reflects great credit upon him as well as upon the Association. If there is any truth in the saying that an association is what its secretary makes it, we have here an excellent example of the power for good in our country's commercial interests which is exerted by an association of specialists, in fact world renowned men in their lines, who in working on standard methods for the common good, have their course shaped, their energies directed, and their results systematised by an exceptionally able Secretary and executive officer.

Our Association is an active member in this work also, and a number of our specialists on cast iron are committee members at work on the standardization of matters pertaining to our industry.

Glancing over the record presented we find the subject of cast iron covering 98 pages, or one quarter of the whole volume, which would certainly be indicative of the great interest being taken in our industry at the present time. The Atlantic City meeting has already been reviewed at length in our Journal, and therefore attention need only be called to a splendid paper on the constitution of cast iron by Prof. Howe, now first published, and which your Secretary will review shortly for our Journal.

Your Secretary can further state that the American Association for testing Materials is just organizing a committee to prepare specifications for testing cast iron and finished castings, of which committee your Secretary has been designated secretary, and over a dozen members are active participants. In the annual report for

the year more will be told of the work as outlined, it being sufficient to say here that a great mass of correspondence comes from Europe as well as from all parts of our country bearing upon the work, all of which indicates the great necessity for improvement in our product, as well as standardization wherever possible.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The Iron Trade Review, Dec. 11, 1902. The 123rd meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club in Philadelphia, on Wednesday, Dec. 3, the newly elected president, Thomas Devlin, occupying the chair.

The treasurer reported a balance in the treasury of $1,994.24, and all bills paid.

A letter was read from J. W. Moyer & Co., announcing their acceptance of the secretary's proposition that they prepare a paper to be read at the next meeting on the subject of "Tramways in Foundries."

The Sheeler-Hemsher Co., of Philadelphia, brass founders, was nominated for membership in the association and duly elected.

An address was made by Armor Ward, president of the American Brazing Co., Philadelphia, his topic being, "Saving the Scrap Pile."

Mr. Outerbridge then, by request of President Devlin, read an address which he had delivered recently to the students of the Wharton School of Finance of the University of Pennsylvania, on "The Premium System of Payment." The address, which was quite long, is to appear in the University Journal in January. Mr. Outerbridge explained that the pupils of the Wharton School visit industrial plants in a body, not so much to study the mechanical features so much as the managerial.

After the reading of the address, Dr. Moldenke, the secretary of the American Foundrymen's Association, addressed the meeting on the subject of affiliation with that organization. He referred to the good work done by the American Foundrymen's Association, and the standards it has promulgated, and urged that by the affilia-

tion of the Philadelphia body the means would be provided for an extension of the work now being done, both in research and standardization. No action was taken in the matter, but it was arranged to bring the subject before the association at its January meeting.

The meeting then adjourned to the club café where a lunch was served and an hour or two pleasantly spent.

The Iron Age, Jan. 15, 1903. The one hundred and twenty-fourth meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club, 1409 Walnut street, in that city, Wednesday evening, January 7. Thomas Devlin, the president, occupied the chair. There was quite a representative attendance.

The reading of the minutes of the previous meeting was dispensed with. The treasurer reported a balance amounting to $1664.42 on hand, with all indebtedness paid.

An application for membership from Van Fleet & Fries, foundry supplies, facing and equipment, 727 Walnut street, Philadelphia, was received, and after favorable action in committee, they were balloted for and elected to membership.

The secretary announced the death of one of the members of the association, George W. Van Tyne, late superintendent of the Singer Sewing Machine Company, Elizabeth, N. J., which occurred on December 11, 1902. On motion of Mr. Rankin the chair appointed a committee to prepare suitable resolutions and to report at the next meeting of the association.

The advisability of the Philadelphia Foundrymen's Association joining the American Foundrymen's Association as a body, or as individuals, was announced as open for discussion. James S. Stirling, Thos. I. Rankin, R. C. Oliphant, H. O. Evans, Geo. C. Davis, W. A. Bole and Howard Evans spoke on the subject, the consensus of opinion being that as many members of the Philadelphia Association are already members of the American Association, and as some members are probably not directly interested, it would be better not to enter the latter association in a body. Howard Evans announced that if a suitable contribution was made to the American Association that body would for the current year send to each member of the Philadelphia Association copies of their *Journal* as published, after receiving which the individual members

would be in a position to know just what the efforts and results of the association are and be able to measure its benefits in their individual cases. A motion was then passed that the sum of $100 be contributed to the American Foundrymen's Association, in view of a return to be made in the distribution of their *Journal* to the Philadelphia Association members

The paper of the evening was by A. W. Moyer, of J. W. Moyer & Co., Philadelphia, Pa., the subject being "Overhead Trolley Systems for Handling Ladles, Metals and Other Materials." It was illustrated by a number of lantern slides. Discussion followed as to the best height from the ground of a tram rail system in general foundry use. Mr Moyer explained that this is governed by individual cases, instances being cited where the tram rail was placed only 5 feet from the ground. The best results are obtained when the height is such as to enable free passage over the tops of molds or such other materials as might be on the floors. After voting thanks to Mr. Moyer for his able paper, the meeting adjourned. The usual lunch was served.

The Iron Trade Review, Feb. 12. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday, Feb. 4, the president, Thomas Devlin, occupying the chair

A memorial to the death of Geo. W. Van Tine, late of the Singer Mfg. Co., Elizabeth, N. J., was presented by a committee, and on motion was adopted and ordered to be spread upon the minutes.

Frank Samuel, iron merchant, Philadelphia, and James S. Stirling, vice commissioner of the National Foundrymen's Association, were elected to membership in the association.

The paper of the evening was by T. J. Fernley, secretary of the Hardware Merchants' and Manufacturers' Association of Philadelphia, and the National Hardware Association. His subject was "Cash Discounts—Their Use and Abuse." The paper dealt with the subject from the standpoint of manufacturer, jobber and retailer, and was very largely based on experiences noted in the hardware field. The author's principal point was that a cash discount should be taken as a premium for prompt payment, and in settling the cost of manufactured products should be classified as a prime

cost equally with raw materials, labor and other expenses. In other words, the discount should be added to the cost or selling price of the goods to furnish a premium for prompt payment under terms of sale in such a way that if not taken advantage of it would stand as a profit. Not only was a cash discount a good thing to stimulate collections, but its acceptance or rejection was an indication of the financial standing of the customer.

Quite a little discussion followed in which a majority of those taking part expressed the opinion that cash discounts in the foundry trade should be discouraged, as there was little chance of establishing any system which could approach the uniformity possible in the hardward trade. While it was suggested that it might be a good matter for the association to take up, the point brought out by those taking part in the discussion presented so many difficulties in the way of united action that the step could not be considered. The paper was exceedingly interesting and was much appreciated by all present.

A discussion on "The Use of Foreign Irons in Foundry Mixtures, in Comparison with Domestic Irons," then engaged the attention of the members.

D. G. Moore—We have not used any foreign irons of late, but I have used plenty at other times. I was offered some a day or two since at $20 put in our yard—pretty cheap iron, if it was any good. It was claimed to be equal to No. 1 American iron, and sold on guaranteed analysis. We had a good stock of iron so the iron did not interest me. We once used Middleboro iron a good deal but did not like it. Some of our neighbors have been using German irons this winter and say they are all right.

Mr. Matthews—We make all our mixtures by analysis, and we have run since early last spring on foreign irons entirely, and with satisfaction. There is one thing to be borne in mind about English iron, that is Middleboro. It is very soft and produces trouble on account of shrinkage, When properly mixed, however, there is no trouble with it. Iron can be obtained from the other side, and we have it, which will make any mixture you want. When working by analysis you are perfectly safe—the defects are all brought out and corrected. Sometimes the foreign irons are misjudged. I recently had a case brought to my notice where a foundry claimed to have produced castings from an English iron and they proved ut-

terly worthless. It was afterward found that none of the iron had been used in the mixture; they had used very heavy scrap. Plenty of iron can be obtained from the other side, and it is satisfactory for all kinds of work.

Mr. Devlin—From your experience, Mr. Matthews, with imported irons, and American irons, which gave you the least trouble and which the best results?

Mr. Matthews—Take the English Middleboro iron, the phosphorus must be looked after. But you can get an iron lower in phosphorus which will make a good mix; for instance, a German iron. A mixture of these irons will give you the same result as American mixtures.

Mr. Devlin—Then you would have to look to England, Scotland and Germany to get the mixtures you want?

Mr. Matthews—Yes. You can get a good Scotch iron which will give you pretty well what you want—that is, if you buy it and use it on analysis.

D. G. Moore—People I have talked to say that the German irons come nearer to being like our own than any foreign irons.

Mr. J. Thompson—We used some foreign iron last fall but did not like it. The first day's heat was disastrous. We have since used other foreign irons with good results. I believe satisfactory mixtures may be made.

Mr. Ridgeway—We tried a little Middleboro iron and had no trouble. We used it sparingly, possibly 25 per cent. We made cylinders, water wheel cases, and other things under conditions where a high shrinkage would be disastrous, and there was no trouble found. We could scrap it rather more heavily than we expected to do. We also used Scotch irons, when we were unable to get our regular softeners, and they worked very nicely. I would have no hesitancy at all to buy foreign iron today if any one has any to figure down on.

Mr. Hitzeroth—We tried a mixture of Scotch and Pennsylvania irons for two weeks, and got very good results.

Mr. Devlin—I think Mr. Matthews stated the case very clearly, and it is a good thing to know that good results can be obtained by intelligent mixing. If a foundryman knows what he wants, anal-

ises his irons, and makes a mixture to suit his requirements, he will get what he wants.

Geo. C. Davis—I have had a number of irons from foreign countries under examination, and I think the reason the German irons have succeeded so well is because they have been pretty nearly what gray irons should be. As to the English and Scotch irons, there has been a great deal of variation found in them. Generally speaking the phosphorus and manganese has been excessive. In Eastern Pennsylvania and New Jersey we have a number of irons which run low in manganese and phosphorus, and with these, and English irons high in phosphorus, provided you know what you are doing, it is possible to make a mixture to get good results. If you use English irons indiscriminately you are bound to get into trouble.

The Iron Trade Review, March 12. The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club, in Philadelphia, on Wednesday evening, March 4, Dr. E. E. Brown occupying the chair in the absence of the president, Thomas Devlin.

A discussion on the topic, "Coal, Coke, Iron—Is it wise to make contracts for future deliveries at present prices?" came under the head of new business. In opening the discussion, Secretary Evans said many foundrymen were asking for information on the possibilities regarding lower prices of these commodities. Present prices for Connellsville coke, he said, seemed to be $6.75 at the ovens, and it is hard to get at that. Whether it would be advisable to place contracts at that price for delivery until July, or whether it would be best to purchase in small quantities as required, was a question of interest to all in the trade.

Stanley G. Flagg—I see that bituminous coal has gone down from $2.50 to $2, and I think now, $1.95. That has possibly some bearing on the question.

J. Thompson—We use coke in a somewhat limited way, but I do not think it policy to buy anything at the present time for more than immediate needs.

W. J. W. Moore—I do not think we are going to have any cheap fuel very soon. In order to get prompt deliveries and a careful selection of coke it would be wise to make contracts now.

Judging from the condition of the railroads the market is not likely to be well supplied with coke. It took recently four days for a car of coke to go from one point in Philadelphia to another.

W. Hanson—We are like nearly everybody else—hesitating about buying.

Dr. Brown—We use about 45 tons of coke a week, and we have found it to our advantage to contract for a year. We are paying $5 a ton at the ovens. We felt that it was a safe thing to do. It is 72-hour coke we use.

H. O. Evans—There has been a lot of very poor stock coming into the market for some time, but I notice it is getting a little better now.

W. J. W. Moore—As far as iron is concerned the prices of standard brands are maintained. The furnaces are behind in their deliveries, even though trying to do all they can. They are getting down to the question of fuel, and I do not see much relief likely to come. As the season advances, a lot of cars will be taken for grain shipment and further trouble will ensue. Deliveries at the present time are freer than they have been. Furnaces are pretty well sold up until July, so there is not much liklihood of price cutting. Recently some large sales have been made to big interests—people who would not come into the market if they thought there was a possibility of a drop in prices. It is only a question of time when all the good brands of iron will be absorbed.

Mr. Haldeman—I think it is advisable for anyone who has sold his product to cover for his requirements in all these commodities. It is not so much a question of price as the ability to get the material. Until the railroads are in such a positiion that they can transport material there is going to be an abnormal scarcity. Today we are sold ahead six months. You will find you will have to pay today's prices for six months. There is a little weakness, it is true, in coal, but it is accounted for. A great many people are shipping coal to get the high prices. It would not be fair to count on today's prices. On April 1st new prices will be fixed and there will be an agreement in all the regions, when you will find there will not be any cutting as before, as the new influences will correct that and see that no more shipments are made than can be used. As far as iron goes, people have been thinking that because of high prices there is bound to be a drop; but it is already found that only about 20

per cent. of the iron required for use has been purchased. Large buyers now are covering and those who do not cover may have to pay higher prices. The trouble is that railroads cannot haul the freight, and while this condition exists there may be a difficulty for consumers to get their wants.

A paper was next read by Dr. Moldenke, secretary of the American Foundrymen's Association, on "The Future of the Foundry Industry."

Stanley G. Flagg—I was surprised at what the Doctor said about the eight-hour day and the idea of working in three shifts. We have had some experience in that direction, although I have heard people say it could not be done. I do not think he exaggerates at all when he says it is not only possible but desirable. I believe the gradual increase of our plants and investments may bring serious conditions when we cannot get business. I have felt that when an increased output is desired it should come through different management, different methods in handling iron and so forth, all tending to double up with little more than an increase in the payroll. If in time business did not warrant a continuance the payroll could then be cut down. Our work being mostly small, the question of two men working on one job never comes up; but I should say that as two men work on one job in the same turn there appears to be no reason why they should not do the same on two turns. We have thought that we made more scrap at night than on day work, but that was due to the fact that the night shift was generally longer than the day shift, and we did not have the same illumination. I feel sure that a plant properly laid out could be run along the lines suggested in the paper.

H. O. Evans—I agree with the Doctor in what he says as to the possibility of a three-turn day. I have kept track somewhat of the theory of a continuous running of a foundry and see no reason why foundries could not adopt it.

Dr. Moldenke—In speaking of the three-shift arrangement I have in mind that the claim for the eight-hour day is that a man wants some time with his family. The second shift could stop at 12 o'clock midnight, and the other come on at 7 o'clock. If these shifts were changed over every two or three weeks a man could get some leisure during daylight. Under arrangements of

this kind when hard times come their plants will not have increased in size.

Dr. Brown—I would like to ask Dr. Moldenke what he means by Russia being our chief competitor?

Dr. Moldenke—I say our greatest future competitor will be Russia. It is a matter of race. I have been in contact with a good many Russians and the impression I have formed is that they are a peculiar people. They will spend any amount of money to see results come 300 years from now. They have sent their engineers everywhere to find out what is going on. In their industrial conditions they get all they can from the foreigners and then drive them out. The only way Russia can get money is to establish industries, and she is doing everything possible to encourage them. In Germany the unions are getting so powerful that conditions there will soon be the same as in England now.

PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The Iron Trade Review, Dec. 4, 1902. The regular monthly meeting of the Pittsburg Foundrymen's Association was held on Monday evening, Dec. 1., at the rooms of the Engineers' Society of Western Pennsylvania.

Mr. E. D. Frohman, of the S. Obermayer Co., read a paper on the manufacture of Sea Coal facing, after which Mr. T. E. Malone, of the J. S. McCormick Co., read a paper on "Foundry Facings."

The two papers were discussed at length, S. D. Sleeth, E. A. Kebler, H M. Wilson, B. D. Fuller, S. H. Stupakoff, G. D. Springer and E. G. Seaman taking part in the discussion. It was stated that ground glass has been used successfully in the place of facings and prevents scabbing. A number of foundrymen stated that they would use this glass in an experimental way during the next few weeks, and reports of the results will be made at the January meeting.

Papers on "Malleable Cast Iron" by H. E. Diller, of Chicago, and the "Melting Ratio" by A. M. Loudon, of New York, were also read, but were not discussed at length. At the January meet-

ing of the association the topic for discussion will be "Fan Blowers." Lunch was served after the meeting adjourned.

January 8, 1903. At the meeting of the Pittsburg Foundrymen's Association, held at Pittsburg, Pa., Monday evening, January 5, the topic under discussion was "Fan Blowers," and an able paper on the subject was presented by R. B. Hayward, Pittsburg, representative of the B. F. Sturtevant Co. There was no discussion as to the relative value of the positive pressure and fan types, and it was decided to have the former discussed at some future meeting. Regarding the use of the fan blower some of the foundrymen stated that they had achieved excellent results from the use of fans, some of them doing excellent service for a period of 25 years. The installation of fans having sufficient volume, according to the statements of some of the foundrymen present, was particularly desirable, one stating that by the installation of a larger fan at his plant the fan could be operated at less speed, requiring less power, and the melt was materially increased. As to the operation of the fan toward the end of a heat, one of the foundrymen stated that he usually increased the pressure owing to clogging up of the tuyers.

Feb. 5, 1903. The regular monthly meeting of the Pittsburg Foundrymen's Association was held at Pittsburg on Monday evening, February 2. An able paper entitled "Gates and Sprues," was presented by B. D. Fuller, of the Westinghouse Electric & Mfg. Co. It resulted in considerable discussion and some interesting points were made relative to the casting of sand and chill rolls. It was stated that an 18 or 20-ton roll is poured in a trifle less than a minute, the fast pouring of the metal causing it to swirl inside of the mold, thereby carrying all the dirt and slag which pass the gates to the top. It was further stated that some twenty years ago an enterprising Pittsburg roll founder secured a patent on the method of swirling the iron inside of the mold, and that another roll maker in the district, in order to avoid an infringement of the patent, had a man stand over the mold while the iron was being poured, with a long pole, which was whirled around in the metal for the purpose of producing a swirling motion. Still another foundryman stated that he remembers the time that in casting rolls one man was engaged in churning the iron in the mold with a green pole causing

it to boil violently and thus bringing the dirt and impurities to the top. It was also stated that in casting car wheels very little time must be lost in getting the metal into the mold. In casting a 700-pound wheel requiring about 900 pounds of metal about 10 seconds is consumed in getting the metal into the mold. This fast pouring in this case has the tendency to carry the dirt to the top and out of the mold.

March 5. The regular monthly meeting of the Pittsburg Foundrymen's Association was held at the rooms of the Engineers' Society of Western Pennsylvania, Pittsburg, Pa., on Monday evening, March 2. George C. Hicks, chief engineer of the P. H. & F. M. Roots Co., of Connersville, Ind., presented a paper on "Rotary Blowers," while the overhead tramrail system of J. W. Moyer & Co., of Philadelphia, was described in an able paper by A. W. Moyer, and illustrated with stereopticon views. The J. D. Smith Foundry Supply Co., of Cleveland, and the Charles G. Smith Co,, dealer in machine tools, of Pittsburg, were admitted to membership.

PROCEEDINGS OF THE NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

The Iron Age, Jan. 22, 1903. The annual meeting of the New England Foundrymen's Association was held on January 14, at the Hotel Essex, Boston. About 60 members were present. The following officers were re-elected: Henry A. Carpenter, A. Carpenter & Sons Foundry Company, president; B. M. Shaw, Walker-Pratt Mfg. Company, vice president; Fred. F. Stockwell, Barbour-Stockwell Company, Secretary; Geo. H. Lincoln, George H. Lincoln & Company, treasurer. The members of the Executive Committee for 1903, are John Magee, Magee Furnace Company; Theodore Colvin, Colvin Foundry Company; William Doherty, Doherty Bros.; James F. Lanigan, Davis Foundry Company; W. H. Bense, Kinsley Iron & Machine Company.

Important changes were adopted in articles II and III of the constitution. Article II, in regard to the object of the association, now reads: "The objects of this association shall be the advancement of the interests of foundry operators and all others engaged in trades allied to the foundry business; to promote the mechanical and

industrial interests; to collect for the use of the association all proper information connected with the foundry business and its allied interests, and to promote harmony and encourage uniform customs and actions among its members." Article III, as amended, reads: "Any person, firm or corporation engaged in the brass, iron or steel business or allied trades is eligible to membership." These changes are important in that they permit all persons allied to the foundry business to become members of the association.

The following were elected to membership: Rufus K. Jordan, Westbrook, Maine; Becker-Brainard Milling Machine Company, Hyde Park, Mass.; D. F. Egan, Lynn, Mass.; O. G. Thomas, Taunton, Mass., B. F. Sturtevant Company, Jamaica Plain, Mass.

Dinner was served at 6 o'clock, after which William J. Keep, superintendent of the Michigan Stove Works, Detroit, and an eminent authority on foundry practice, addressed the association on Cupola Mixtures, regulating quality by chemical analysis and by mechanical analsis.

At the regular meeting of the New England Foundrymen's Association, held on Feb. 11th, Dr. Richard Moldenke, Secretary of the American Foundrymen's Association, read a paper on the "Valuation of Pig Iron for Foundry Purposes." A long discussion followed the paper. The Association conferred honorary membership upon Dr. Moldenke by rising vote.

The Iron Age. March 19. A meeting of the New England Foundrymen's Association was held at the Hotel Essex, Boston, on Wednesday, March 11. Forty-five members were present. There was a business meeting in the afternoon, at which the following firms were admitted to membership in the association: Coburn Trolley Track Company, Holyoke, Mass.; Alger Foundry Company, West Bridgewater, Mass.; Hugh W. Adams, Boston; Rogers, Brown & Co., Boston; Matthew Addy & Co., Philadelphia. There was an informal discussion in regard to the future plans of the association. Dinner was served at six o'clock.

The speaker for the evening was R. P. Cunningham, superintendent of the Dean Steam Pump Company, Holyoke, Mass., and a member of the association, who spoke on "Melting Steel with Cast Iron." At the close of the address a rising vote of thanks was

given Mr. Cunningham, and W. R. Billings, F. F. Stockwell, F. W. Stickle, J. Magee and others discussed the subject interestingly with the speaker. Not by any means the least among the many good things that were brought out during the evening was a humorous story told by Mr. Cunningham in regard to his experience with test bars on Government work.

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS.

Journal of the American Foundrymen's Association.

VOL. XI. APRIL, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECT'Y.

STANDARD METHODS FOR ANALYZING IRON.

INTRODUCTION.

As early as 1899 the American Foundrymen's Association instructed its Standardizing Committee to take steps looking towards the adoption of standard methods for determining the constituents of cast iron. The complaint from furnace-man and founder that the results of different chemists did not agree had become so pronounced that the Association determined to remedy this trouble if possible. It is a well-known fact that very few chemists use exactly the same methods in analyzing iron. This great variation in methods used made possible a source of error which could be overcome by the adoption of standard methods. This question has been prominently before iron chemists for some time, and American, German and Swedish committees have already taken up the methods for the determination of carbon in iron. The American Committee has made their decision in favor of the so-called Copper and Potassium Chloride Method. The fact that this method has been generally adopted by American chemists would indicate that a complete list of standard methods would have a similar reception.

The adoption of standard samples by the American Foundrymen's Association has been a great help towards more accurate commercial work in chemical laboratories. The improvement in methods of sampling pig iron now before this Association for consideration is another step towards the same end. With purer chemicals and standard methods for analysis, the bugbear of inac-

curate chemical work will be abolished. The error, if there be any, will have to be placed on the operator.

This would be an ideal condition in which all foundry and furnace laboratories used the same method of sampling, the same standards for guides, and standard methods for their analysis work. The most ardent supprters of the scheme for standard methods can only hope to approach this ideal. The varying conditions under which different chemists work render impracticable the adoption of rigid standard methods. The work of the, Association, to be of permanent value must be sufficiently flexible to conform itself to all conditions of iron analysis. The furnace laboratory, the commercial laboratory with several chemists and the small foundry laboratory with its single chemist present three different phases of the question which must be considered. In many furnace laboratories the casts of one day must be analyzed and ready for piling or shipping the next morning. This makes absolutely necessary the use ot methods which give rapid results. The malleable foundry's product may require to be analyzed for silicon while the bath is still molten. The large commercial laboratories must use methods which give prompt results, thus making way for new work.

In contrast with these are the increasing number of small laboratories in separate foundries, each with its single chemist. The aim of the latter is to accomplish the greatest possible amount of work within a specified time,rather than to finish one determination in the shortest possible time. In the former case methods are indispensable which give immediate resulte regardless of the amount of labor required during that time. In the latter case methods which require the least amount of actual time of the chemist are the best suited.

In order to find out just what methods were in use in the different iron laboratories, Mr. West, chairman of the Standardizing Committee, sent requests to many chemists asking them to furnish him a description of the methods used in their laboratories. A considerable number of replies were received to these requests, which, in course of time, were referred to the Secretary of the Metallurgical Section for editing. The number of replies received was not as large as was desired, and an effort will be made to obtain a more representative collection.

The methods sent in are being classified and edited and will be

published in the "Journal" as fast as this work is completed. These classified results will be sent out to chemists all over the country with a request that any methods or operations not included in the report, be sent to the committee. When a sufficiently representative collection is secured, the matter will be referred to a committee for the purpose of selecting the most suitable for use as standard methods It would be impracticable to publish in detail each and every method sent to the committee. They will be outlined in one general scheme and all methods, or modifications of methods, will be included in this outline.

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. APRIL, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETATY.

STANDARD METHODS FOR ANALYSING IRON.

SILICON.

All methods for the determination of silicon in iron in common use depend upon the separation of the silicon from the iron by dissolving the latter in an acid or a combination of acids which will rapidly take it up and leave the silicon in an insoluble condition. All acids dissolve silicon under certain circumstances. If a sample of pig iron is dissolved separately in nitric, sulphuric and hydrochloric acid, the largest amount passes into solution in the nitric acid, and the least in the hydrochloric acid. It is known, however, that if iron dissolved in acid be evaporated with sulphuric or hydrochloric acid sufficiently to dehydrate the silicon, then the latter becomes practically insoluble.

The different methods now in use depend upon this fact and may be divided into two general classes : Sulphuric Acid Methods; Hydrochloric Acid Methods.

The following outline of the methods now in use is drawn from the methods sent in by various chemists and as quoted by them from current books and journals. As an outline, I have taken two methods given in Blair's Chemical Analysis of Iron, and have inserted as modifications the differences which appear in other methods.

OUTLINE.

FIRST STEP.—Weighing out the sample.

Weigh out 1 gram of sample into beaker or dish which is to be used for the determination.

MODIFICATIONS.

Use for charge 3 grams, 2 grams, .934 grams, .940 grams, .4702 grams, .466 grams. (The decimal weights are factor weights

or twice factor weights and are used to simplify the figuring out of per cent. of silicon at the end of the determination.)

SECOND STEP.—Solution of the sample.

(The kind and strength of acids used are a prominent factor in the accuracy and speed of the determination. The two methods divide at this point and for four steps will be outlined separately.)

1. SULPHURIC ACID METHODS.

(By far the larger number of chemists use some modification of this method for the determination of silicon in iron. The great variety in the strength and amount of acids used will be noted. This point is one which will readily lend itself to standardization. If the small amount of acids used per gram by some chemists is sufficient, the waste of time and acids by others is quite remarkable.)

A. Dissolve the sample in 20 c. c. nitric acid, 1.20 specific gravity and, when the action has ceased add 20 c. c. of sulphuric acid (1 of acid to 1 of water.)

MODIFICATIONS.

Use 30 c. c. nitric acid 1.20 sp. gr., add 15 c. c. sulphuric acid (1 - 3). Use 20 c. c. nitric acid, 1.20 sp. gr., then add 10 c. c. sulphuric acid (1 - 3).

B. Dissolve the sample in 16 c. c. dilute sulphuric acid, and when action has ceased add 8 c. c. nitric acid, 1.20 sp. gr.

(In the above and in succeeding cases where other than one gram was used for a charge, I have, for uniformity, proportioned the amount of acid used to a one gram charge.)

C. Dissolve the sample in a mixture of sulphuric acid, nitric acid, and water.

a– Add sufficient amount of mixture, 1 of sulphuric, 1 of nitric, 2½ of water.

b– Add 20 c. c. per gram of mixture, 1 of sulphuric, 1½ of nitric, 3 of water.

c– Add sufficient amount of mixture, 1 of sulphuric, 1¾ of nitric, 3.2 of water.

d– Add 40 c. c. per gram of mixture, 1 of sulphuric, 2 of nitric and 5 of water.

e– Add 30 c. c. per gram of mixture, 1 of sulphuric, 2½ of nitric, 3 of water.

MODIFICATIONS.

Use 20 c. c. per gram of same mixture.

f– Add 30 c. c. per gram of mixture, 1 of sulphuric, 2.6 of nitric, 5.8 of water.

g– Add 50 c. c. per gram of mixture, 1 of sulphuric, 3 of nitric and 6 of water.

h– Add 30 c. c. per gram of mixture, 1 of sulphuric, 3¼ of nitric, 10 of water.

MODIFICATIONS.

Add 20 c. c. per gram. Add 60 c. c. per gram.

i– Add 35 c. c. per gram of mixture, 1 of sulphuric, 4 of nitric, 12½ of water.

D. Dissolve sample in mixture of sulphuric acid and aqua regia.

a– Add 30 c. c. per gram of mixture, 1 of hydrochloric, 3 of sulphuric, 6 of nitric, and 12 of water.

b– Add 30 c. c. per gram of mixture, 1 of hydrochloric, 5 of sulphuric, 5 of nitric and 10 of water.

E. Dissolve the sample in mixture of sulphuric acid and water.

a– Add 70 c. c. per gram of mixture, 1 of sulphuric, 2½ of water.

b– Add 15 c. c. per gram of mixture, 1 of sulphuric, 3 of water.

c– Add 20 c. c. per gram of mixture, 1 of sulphuric, 6 of water.

d– Add 20 c. c. of mixture, 1 of sulphuric acid and 8 parts of water.

e– Add 30 c. c. per gram of mixture, 2½ sulphuric acid, 1 of water.

f– Add 50 c. c. of water, then 20 c. c. sulphuric acid, 1.84 sp. gr.

THIRD STEP.—Evaporation of the solution, and dehydration of silica.

Evaporate the solution of the drillings on a hot plate until copious fumes of sulphuric acid are given off.

MODIFICATIONS.

Evaporate over free flame to copious fumes of sulphuric acid.

Evaporate over free flame with inverted watch glass until residue

spatters on the glass and sulphuric acid fumes are given off.

Use strap around dish, and prevent spurting by giving dish a circular motion.

Evaporate a few minutes after fumes begin to come off as the more complete the dehydration the more readily will the silicon filter.

Cool with blast of air.

(*It is at this point that the difference in the speed of the determination is most noticeable. It is probable that the greatest error of the method is due to a too short heating after the fumes of sulphuric acid begin to come off.*)

FOURTH STEP.—Solution of the ferrous sulphate.

Dilute with water and boil until all the sulphate of iron is dissolved.

MODIFICATIONS.

Saturate first with strong hydrochloric acid and boil, after adding 25 c. c. of water.

Add 5 c. c. of concentrated hydrochloric acid, add water and boil.

Add a few c. c. of dilute hydrochloric acid, add hot water and boil.

Add 60 c. c. of hydrochloric acid, 1 - 5, and boil.

Add 30 c.c. of water, 30 c.c. dilute hydrochloric acid and boil.

Add 20 c.c. hydrochloric acid 1 - 1 digest for five minutes at 50° C., add 30 c. c. of water and bring to boiling.

Add 10 to 15 c. c. concentrated hydrochloric acid, re-evaporat to dryness, take up with 10 c. c. hydrochloric acid, add water and boil.

Add 15 c.c. chromic acid solution, (120 gr. to liter) boil until chromic acid begins to crystalize out, add water and boil.

(*The great differences in these steps should be noted. If the silica has any tendency to dissolve in hydrochloric acid, it would appear that the regular method of Blair, in which he dissolves the sulphate in water and then washes the silica on the filter with dilute hydrochloric acid, would give more accurate results than these methods which treat the silica immediately with concentrated hydrochloric acid.*)

FIFTH STEP.—Filtering off the silica.

Filter on an ashless filter.

MODIFICATIONS.

Fit an ashless filter paper closely to a funnel, then pierce the point with a glass needle and place plug of best absorbent cotton in the filter and fit it closely to the latter. Wash the filter with distilled water and filter the solution.

MODIFICATIONS.

Use a platinum cone (perforated) with suction for rapid filtration. The filter paper must be strong and fine.

(*The rapid methods of filteration hasten the process. Suitable platinum cones are expensive but if the pierced filter using cotton were accurate, it would be a great saver of time.*)

SIXTH STEP.—Washing the silica.

Wash with hot hydrochloric acid 1 - 1 until free from iron, then with hot water until the residue is free from acid.

MODIFICATIONS.

Same as above, using hot dilute acid and cold water alternately until free from iron.

Wash with hot hydrochloric acid 1 - 3 until free from iron, then with hot water until free from water.

Wash with 5 per cent. nitric acid, and then with water.

(*The washing of the silica is an important step in the determination. An extra moment spent here may save a half hour at the end of the determination.*)

SEVENTH STEP.—Burning off of the filter paper and graphite.

Burn wet in a weighed platinum crucible.

MODIFICATIONS.

Absorb the moisture from the filter paper with blotting paper before burning in the crucible.

Burn in platinum crucible, using oxygen and blast lamp.

Burn with blast lamp and uncovered crucible, after charring the filter paper.

Burn in platinum or porcelain crucible in muffle.

EIGHTH STEP.—Weighing of the silicon dioxide.

Weigh the crucible before and after burning off; difference gives the weight of silicon dioxide.

MODIFICATIONS.

Brush the contents of the crucible into balance pan and weigh directly.

Weigh crucible containing silicon dioxide. Brush out the silica, and weigh the empty crucible. Difference gives weight of silicon dioxide.

NINTH STEP. Checking the Silicon dioxide.

Treat the silicon dioxide in a platinum crucible with a few drops of sulphuric acid. Fill the crucible with hydrofluoric acid, evaporate to dryness, and heat over the blast flame and weigh. The loss in weight is the silicon dioxide.

MODIFICATIONS.

Add to the silicon in the crucible 5 times its weight of sodium carbonate, fuse, treat with an excess of strong sulphuric acid, heat until fumes of sulphuric anhydride come off. Cool, dissolve in water, filter, wash well, ignite and weigh as pure silicon dioxide.

Fuse the silicon dioxide with acid potassium sulphate. Heat until fumes arise, cool, treat with dilute hydrochloric acid, filter off the purified silicon dioxide, wash, ignite, and weigh, etc.

2. HYDROCHLORIC ACID METHOD.

(*Quite a large number of chemists prefer this method to the sulphuric acid method. This is chiefly due to the fact that if the sulphuric acid is not sufficiently evaporated, the silica may not be all dehydrated, while when hydrochloric acid is used, it is very easy to note when the solution is sufficiently evaporated to dehydrate the silica.*

SECOND STEP.—Solution of the sample.

a– Add to the drillings in beaker or evaporating dish, 20 c. c. of nitric acid, 1 - 20 sp. gr. When the solution is complete, evaporate to dryness in an air bath and then raise the temperature sufficiently to decompose the nitrate of iron.

MODIFICATIONS.

Evaporate in a porcelain evaporating dish over free flame and heat until nitrate is decomposed.

b– Dissolve the drillings in 10 c. c. strong hydrochloric acid, evaporate to dryness and to dehydration of the silica.

MODIFICATIONS.

Dissolve drillings in 40 c. c. concentrated hydrochloric acid. Evaporate to the dehydration of the silica.

Dissolve drillings in a sufficient quantity of hydrochloric acid 2 to 1, etc.

Dissolve drillings in 30 c. c. hydrochloric acid 1 - 3 etc.

THIRD STEP.—Solution of the nitrate and chloride.

Redissolve in 6 c. c. strong hpdrochloric acid. Dilute with water and boil.

MODIFICATIONS.

Saturate with strong hydrochloric acid, add 20 c. c. of water and boil.

Add 10 c. c. of concentrated hydrochloric acid, add water and boil.

Add 30 c. c. hydrochloric acid, 1 - 3, and boil.

The fourth and remaining steps are identical with the steps in the Sulphuric Acid Method.

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETATY.

STANDARD METHODS FOR ANALYSING IRON.

SULPHUR.

There are two classes of methods in general use for the determination of sulphur in iron: the evolution method, in which the sulphur is evolved from the iron as hydrogen sulphide by hydrochloric acid, and taken up in some absorption solution; and the gravimetric methods, in which the sulphur is oxidized to sulphuric acid and determined as barium sulphate.

— — —

Evolution Methods.

There are hundreds of chemists using modifications of this method, many of which give but 50 to 90 per cent. of the total sulphur in the iron. They know the method to be inaccurate but lack of time or disposition to perform the longer and more accurate methods cause the great discrepancy in results shown in the work of different chemists in determining sulphur in iron.

The errors in these evolution methods may be due to several causes. It has been shown that the rate of evolution of the gas causes a wide variation in the sulphur percentages. Matthewman (West of Scotland Iron and Steel Inst. Section of 1895 - 6) shows

the following almost unbelievable results on a pig iron carrying .15 per cent. sulphur by the gravimetric method.

Time of Evolution	% Sulphur
Very fast	.132
Rapid	.122
Ordinary rate	.092
Slow	.076
Very slow	.049

Phillips has shown that a part of the sulphur is evolved as an organic sulphide which is very volatile and which either passes through the absorbtion solution or remains in the evolution flask. Shimer & Blair (Mexican meeting American Society of Mining Engineers) announced the existence in some irons of a carbon-titanium-sulphur compound which is not decomposed by hydrochloric acid. Others have claimed that arsenic and copper form sulphides which are precipitated in acid solutions. Some chemists insist that hot hydrochloric acid is necessary for the maximum evolution of hydrogen sulphide gas; while others use cold dilute hydrochloric acid. The evolution of the sulphuretted hydrogen in air is sometimes accompanied by the oxidation of some of the gas due to the presence of a little ferric chloride. This latter error is avoided by many who liberate the gas in an atmosphere of hydrogen. The above and some other possible errors render the evolution methods at best doubtful for iron. The suggestion that the sample be annealed before transferring to the evolution glass may solve many of these difficulties, provided that further investigations prove to be as satisfactory as first experiments. It is considered that sulphur may be evolved from iron by heating it in a current of hydrogen. At how low a temperature this occurs we do not know, but this fact may eventually interfere with a full realization of what is expected from the annealing method.

APPARATUS.

1. A tank of hydrogen or hydrogen apparatus with purifying bottle.

MODIFICATIONS.

This is very generally omitted.

II. Evolution flask; a flat bottom flask fitted with funnel and delivery tube.

MODIFICATIONS.

A wide necked carbon dioxide flask containing a three hole stopper with entrance tube going nearly to the bottom of the flask (to connect with the hydrogen apparatus) a small separatory funnel and a delivery tube.

III. Condensing flask; a small flask connected with the delivery tube from No. II, containing an entrance and an exit tube; the entrance tube passing nearly to the surface of a small amount of water in the bottom.

MODIFICATIONS.

An empty flask which is surrounded by cold water.

A two bulb tube in place of flask.

A water jacketed condensing tube in place of flask.

No. III is very generally omitted and the delivery tube from No. II passes directly to the absorbtion flask or tube No. IV.

IV. Absorbtion flask; a small flask or bottle containing the absorbtion solution (this connects with III, or II when III is not used.

MODIFICATIONS.

Tubes of the following sizes are used in place of flasks : 25 x 2½ c. m. 1 x 8 in. 1 x 10 in.

A 350 beaker is used in place of flask.

A three bulb nitrogen tube is used in place of flask.

SOLUTIONS.

1. Absorption Solutions.

Cadmium chloride solution was used in by far the largest number of methods received. These solutions vary greatly in strength. A representative selection of those received is given below. The proportions have been reduced to liter solutions for uniformity.

Cd. Cl_2.	1.25	5	5.44	9	12.4	12.5	14	15	20	20	30
H_2O	730	166	908	273	370	125	395	800	550	625	300
NH_3 H_2O	270	834	92	727	630	875	605	200	450	375	700

Combined Starch and Cadmium Chloride Solution.

Make 8 grams of fresh starch to a cream with cold water, add this to 200 c. c. boiling water, add to the clear part 20 c. c. of hydrochloric acid which throws down a precipitate. When it settles decant and dilute the clear solution to 1500 c. c., add to this 40 grams of cadmium chloride and 1000 c. c. of ammonia.

Alkaline lead nitrate solution. Add a solution of lead nitrate to caustic potash 1.27 sp. gr. until a permanent precipitate is produced. Siphon off the clear liquid for use.

Zinc Solutions	Zinc Sulphate	14	25	Zinc Chloride	20
	Water	930	875	Water	395
	Ammonia	70	125	Ammonia	600
				Hydrochloric Acid	5

Potassium Hydrate Solution : 1 lb. in 17 litres of water, and a 10 per cent. solution, are used.

Sodium Hydrate Solution of 1.10 specific gravity, is used.

2. Titrating Solution. (The weights given below are the number of grams to the litre of water.

Iodine	.65	1	1.7	1.75	1.92	2	3.26	3.92	3.95	4	4.6	6.5
Potassium Iodide	.9	5	10	3.5	3.6	3	7	20	6	8	10	9

25 gr. Iodine and 70 gr. potassium iodide are diluted to make 1 c. c. of the solution equal to .005 sulpur when a 5 gr. charge is taken.

2.017 grams of potassium permanganate, 30 grams of potassium iodide, 20 c. c. sulphuric acid (1 to 3) and 1 litre of water. Then make this up to 2 litres.

Mix 5 grams of potassium iodide, 15 c. c. of sulphuric acid, (1 to 1) and 1000 c. c. of water. Add to this the calculated amount of potassium permanganate to make the solution titrate 1 c. c. equals .01 per cent. sulphur for the desired charge to be used.

6 grams potassium iodide, and 150 c. c. of water are transferred to a litre flask, add the amount of potassium permanganate deduced from formula, then add 20 c. c. sulphuric acid (1 to 3) and make up to 1 litre.

Divide the iron factor of potassium permanganate solution into

1.75 in order to get the number of c. c. permanganate solution to make 1 litre of iodine solution.

10 grams potassium iodide are mixed with 15 c. c. dilute sulphuric acid. Add the requisite number of c. c of potassium permanganate solution. Shake during the addition. Make up to 1 litre with water. 1 c. c. equals .01 per cent. sulphur when a 5 gram charge is used.

This solution was standardized against sodium hyposulphite and potassium bichromate; sodium thiosulphate (which has been standardized against the previous iodine solution); a standard (gravimetric) steel sample; standard (gravimetric) shot sample; a standard (gravimetric) pig or cast iron sample.

(The standardizing of the solutions is a very important step in the evolution method. The increasing custom of standardizing the solution against a gravimetric standard sample of cast iron produces results nearer the total sulphur in some cases than when the sample is standardized against the hyposulphite solution. It would appear, however, that it causes a large error in some other instances. For example, if a solution is standardized against a sample of cast iron whose gravimetric sulphur was say .08, and whose evolved sulphur only .05, the iodine solution would be given a false value. This would not be noticeable as long as the ratio between the evolved and total sulphur held constant in the samples analysed. For example, take a sample in which the total and evolved sulphur are nearly the same and titrate this with a solution which has been standardized against a sample whose evolved and gravimetric sulphur vary greatly.

The high value given to the standard solution by the great variation in the standand sample would cause a wide error in the sample under analysis.)

OUTLINE.

PREPARATORY.

After weighing out the drillings, they are annealed in a combustion tube for one-half hour in a current of hydrogen.

MODIFICATIONS.

Drillings are placed in a rose crucible and annealed in a current of hydrogen for fifteen minutes.

Drillings are placed in a porcelain crucible covered with a

filter paper and annealed at red heat for fifteen minutes.

(This step has but recently been introduced, and is not very generally used. It has already been commented on in the introduction.)

FIRST STEP.—Place 10 grams of the finely divided sample in the evolution flask and connect up apparatus.

MODIFICATIONS.

Weigh out 6.878 grams. (Factor weight.)

Weigh out 1 to 5 grams according to the supposed sulphur percentage in the iron.

(The charges vary from 1 to 10 grams in the different lists sent in.)

SECOND STEP.

Pass a current of hydrogen through the apparatus until all the air is expelled. (This is very generally omitted in the methods sent in.)

THIRD STEP.

100 c. c. of hydrochloric acid (1 to 1) (10 c. c. to each gram) are run into the flask through the separatory funnel.

MODIFICATIONS.

5 c. c. of water per gram is run into the flask from the separatory funnel and then 5 c. c. per gram of hydrochloric acid is allowed to drop slowly on the water covered drillings.

Run 16 c. c. of a (3 to 5) solution of hydrochloric acid directly into the flask.

Run 60 c. c. of hydrochloric acid (1 to 1) to a 3 gram charge, directly into flask.

Run 80 c. c. of hydrochloric acid (1 to 2) to a 5 gram charge, directly into flask.

Add to 5 gram charge 100 c. c. of boiling water, then immediately 50 c. c. strong hydrochloric acid.

FOURTH STEP.

Pass a current of hydrogen through the apparatus during the whole determination and regulate by this means the flow of bubbles

through the absorption solution. (This is very generally omitted in the methods sent in.)

FIFTH STEP.

When the drillings are dissolved, boil for 15 minutes. Then turn off the heat and allow hydrogen to pass through the apparatus for ten minutes.

MODIFICATIONS.

Heat is applied when the water is added and increased gradually as the hydrochloric acid is dropped in from the separatory funnel until when all the hydrochloric acid is in, the drillings should be dissolved and the solution in the flask should be nearly to the boiling point. Then boil for 10 minutes.

When the action from the boiling has ceased, draw a current of air through the apparatus to free it from hydrogen sulphide gas.

Boil until the tube connecting the evolution flask with the absorption flask is hot and steam begins to condense in it. (No hydrogen is used.)

(This modification was most generally used in the methods received. It does not seem possible that simply boiling the solution would expel sufficient air from the flask to force out all the evolved hydrogen sulphide gas. This would seem especially true as this boiling was in almost every case limited to the time that a small amount of steam condensed in the evolution tube. The care which some expert chemists take in running a current of hydrogen through the apparatus before and after the evolution of the hydrogen sulphide would indicate that in a majority of methods in general use there would be an error caused by hydrogen sulphide gas if left in the evolution flask.)

SIXTH STEP.

A.—The absorbtion solution, potassium hydrate solution of nitrate of lead, is filtered on a small filter and the lead sulphide is washed twice with hot water and then the precipitate and filter are thrown into a beaker into which has been placed the instant before some powdered potassium chlorate and 5 to 20 c.c. of hydrochloric acid, according to the amount of precipitate of lead sulphide. Allow to stand in a warm place until fumes partly pass off. Add twice its

bulk of water and filter. Heat the filtrate to boiling and make ammoniacal. Acidulate with a few drops of hydrochloric acid and add 5 to 10 c. c. barium chloride solution (1 to 10). Boil 15 to 20 minutes. Allow to stand one-half hour, filter on a Gooch crucible, wash with hot water, ignite and weigh as barium sulphate.

B.—When sodium hydrate and potassium hydrate were used for absorbtion solutions, they were transferred to the beaker acidulated with hydrochloric acid, starch solution was added and then the solutions were titrated with standard iodine solution.

C.—When cadmium chloride was used, the cadmium sulphide was collected on a filter, washed, placed in beaker containing cold water, enough hydrochloric acid added to dissolve the precipitate and titrated with the standard iodine solution.

D.—When cadmium sulphate was used the same operation was carried out as when cadmium chloride was used.

MODIFICATIONS.

The cadmium sulphide was filtered through a Gooch crucible, dried at 100° C. and weighed direct.

E.—When zinc chloride or zinc sulphate solutions were used, the same operation as indicated in C were carried out.

Oxidation Methods.

This method, or some modification of it is generally resorted to by chemists when an exact determination of sulphur in iron is required. The method, however, is not without its defects. The great variation in the details in order to remedy these defects has so changed the original method that in many cases it is hardly recognizable. From the treatment of the drillings with nitric acid and a little sodium carbonate, evaporating to dryness, resolution in hydrochloric acid and precipitation with barium chloride as recommended and practiced by some prominent chemists, the method has been complicated by re-evaporations, the addition of zinc and tartaric acid, the use of aqua regia and bromine for solutions, in fact every step of the process has been modified until the gravimetric determination of sulphur in many modern laboratories, means a two day's operation. I make this fact prominent because if the short methods are sufficiently accurate for some of the standard

authorities who recommend them, it seems a waste of time to encumber the method with so many so-called improvements for defects which are many times imaginary. The strong tendency of the barium sulphate precipitate to carry down as impurities, barium, sodium, potassium, etc., renders the method subject to errors which modifications have by no means completely overcome.

OUTLINE.

PRELIMINARY.

The blank analysis of chemicals used.

A.—Measure out the total amount of nitric and hydrochloric acid used in the determination. Add a little sodium carbonate and evaporate to dryness. Redissolve in 15 c. c. of water and 5 to 10 drops of hydrochloric acid, filter, heat to boiling, add 10 c. c. of barium chloride, boil 10 minutes, filter, wash, ignite and weigh as barium sulphate. The amount found is to be subtracted from the total weight of barium sulphate found in the sample.

MODIFICATIONS.

Add a pinch of pure Swedish bar iron to the acid solution before evaporation.

B.—Perform an analysis of steel practically free from sulphur. The amount of sulphur obtained is considered as due to reagents.

C.—Perform a determination on a sample of iron, using a 5 gram charge and the usual amount of reagents, then perform the same operation on the same sample using one-half of 5 grams, or 2½ grams for a charge and use the same amount of reagents as were used with the five gram charge. Multiply the weight of barium sulphate obtained in the second determination by two and subtract from it the weight obtained in the first determination and the difference gives the amount of barium sulphate due to reagents.

(There is a great difference of opinion in regard to the accuracy of the ordinary method of determining the sulphuric acid in the chemicals used. Some claim that in the Blank determination carried on without a sample of iron some sulphuric acid is driven off in the evaporation of the original solution to dryness. The use of a small amount of bar iron with .01 sulphur to fix the sulphur as non volatile sulphate of iron is recom-

mended to overcome this. Others claim that the only accurate method is to perform an accurate determination on the sample of steel which has the negligible amount of sulphur. They state that it is not the total amount of sulphur in the reagents which is required so much as the amount which affects the determination. It is also claimed that the practice of using a low sulphur iron to determine the purity of the re-agents largely eliminates any errors due to inherent defects of the method.)

FIRST STEP.

OXIDATION AND SOLUTION.

Treat 5 grams of drillings with 40 c. c. of concentrated nitric acid and when the action has ceased, heat on the sand bath, adding a few drops of hydrochloric acid to complete the solution.

MODIFICATIONS.

Treat 5 grams of drillings with a mixture of 5 c. c. concentrated hydrochloric and 40 c. c. strong nitric acid and when the action ceases add 40 c. c. of concentrated hydrochloric acid.

Treat 5 grams with a mixture of 36 c. c. nitric acid and 4 c. c. hydrochloric acid, or 45 c. c. of nitric acid and 5 c. c. of hydrochloric acid.

Treat 5 grams with 50 c. c. nitric acid and when action ceases add 15 c. c. of hydrochloric acid.

Treat 3.435 grams with 25 c. c. nitric acid and 15 c. c. hydrochloric acid.

Treat 5 grams of drillings with 20 c. c. of bromine water and 60 c. c. of water.

Treat the drillings with a sufficient quantity of dilute bromine or nitric acid, patassium bromide and potassium chlorate mixture. (Method of Noyes and Helmer.)

Add sufficient amount of aqua regia very slowly to the drillings.

(There is a difference of opinion as to the best reagents for the oxidation and solution of the sample. Blair says that strong nitric acid should be used as when dilute nitric or even aqua regia is used, some of the sulphur escapes oxidation. Several chemists have pointed out that sulphur is evolved as hydrogen sulphide when iron is treated with nitric acid or aqua regia. Auchy minimizes this evolution by adding aqua regia very slowly.)

SECOND STEP.

EVAPORATION AND REDISSOLVING.

Add to the solution a small amount of sodium carbonate.

MODIFICATIONS.

Add one-half gram sodium carbonate.

Add one gram of sodium carbonate.

Add one-half gram of potassium chlorate.

Add one-half gram of potassium nitrate.

The addition of any salt is frequently omitted.

(*The addition of the salt has been fouud necessary to keep the sulphuric acid in a non volatile form.*)

B.—Evaporate to dryness.

MODIFICATIONS.

When nitric acid or aqua regia have been used for solution the evaporation is continued until the solution reaches 10 c. c., then add 30 c. c. of hydrochloric acid and evaporate to dryness.

Heat one-half hour after evaporating to dryness.

(*Some chemists contend that the solution should be simply evaporated to dryness and must not be burned, while others are in favor of baking for one-half hour to destroy carbonaceous matter and to decompose the nitrate, as th latter are supposed to cause the barium sulphate to carry down impurities.*)

C.—Redissolve in 30 c. c. of hydrochloric acid.

D.—Evaporate again to dryness.

(This evaporation is very generally omitted.)

E.—Redissolve in from 20 to 40 c. c. of hydrochloric acid.

(*The methods do not agree on the necessity of the second evaporation and resolution. Some claim that the step is necessary to render the silica insoluble. Others state that even if the silica does dissolve it will not be precipitated by the barium chloride.*)

THIRD STEP.

EVAPORATION TO SMALL VOLUME.

Evaporate until ferric chloride just begins to separate out, then add 2 c. c. of hydrochloric acid.

MODIFICATIONS.

Evaporate to the same point and add 5 c.c. of hydrochloric acid.

Evaporate to the same point and add a few drops of hydrochloric acid.

Evaporate to small volume, about 10 c. c., but not necessarily to the separation of the chloride.

Evaporate to a syrup after adding 5 grams of sodium chloride. (The sodium chloride is supposed to form a double chloride which assists in the evaporation to small volume with the smallest possible amount of free acid.)

(A large number of chemists still cling to the belief that the solution must contain the smallest amount possible of free hydrochloric acid at this point in the operation. Several chemists have proved that a moderate acid solution is better suited for the correct precipitation than the nearly neutral solutions formerly used.)

FOURTH STEP.

FILTRATION AND DILUTION.

Dilute the solution with a small amount of water and filter. The filtrate should not exceed 100 c. c. in volume.

MODIFICATIONS.

The filtrate should equal 200 c. c. in volume.

The filtrate should be diluted to 400 c. c. in volume.

The filtrate should be diluted to 75 to 100 c. c. for each gram of the charge.

(It will be noted that a wide difference in opinion is prevalent in regard to the strength of the solution best suited for the precipitation of the barium sulphate. Some use very concentrated solutions, while others state that dilute solutions are necessary. The latest experiments would tend to show that the concentrated solution is most favorable to the complete precipitation.)

NOTE—In the Noyes & Helmer method the iron is precipitated by ammonia before the addition of the barium chloride as in step No. 5.

FIFTH STEP.

PRECIPITATION.

Heat the solution to boiling and add 10 c. c. of a saturated solution of barium chloride and allow to stand in the cool over night.

MODIFICATIONS.

Add 5 c. c. of a saturated solution and allow to stand over night at a temperature of 40° C.

In place of the saturated solution the following dilute solutions were used.

a– 10 per cent. solution. b– 15 c. c., 10 per cent. solution. c– 3 c. c., of a 5 per cent. solution. d– 5 c. c., of a 5 per cent solution.

Add 10 c. c. of 5 per cent solution of barium chloride, evaporate nearly to dryness, add 2 c. c. hydrochloric acid, dilute with cold water and set aside over night.

Add 10 c. c. of a 10 per cent. solution of barium chloride, evaporate until a film forms on top, add a drop or two of hydrochloric acid then force a stream of water into the solution until it reaches 175 c.c., set aside in a cool place over night.

To the boiling solution add 3 c.c. of barium chloride. Allow to stand over night on a warm plate, evaporate till a crust forms, add a few drops of hydrochloric acid, dilute with water, evaporate again until a crust forms, add a few drops of hydrochloric acid, dilute and stand over night at the temperature of the room.

(The variations in method and solutions used in this step make possible several errors. The practice of re-evaporation to a crust after precipitation is still adhered to by a majority in spite of the fact that many of our best chemists do not find this to increase the accuracy of the method. The practice of precipitating the barium sulphate in concentrated boiling solution is held by Arnold to precipitate a basic iron salt, insoluble in very dilute hydrochloric acid. Archbutt found that when concentrated and somewhat acid solutions were used, the precipitation was complete in two hours.

SIXTH STEP.

FILTERING AND WASHING THE BARIUM SULPHATE.

Filter off the barium sulphate precipitate on a small filter. Wash with very dilute hydrochloric acid and finally with cold water.

MODIFICATIONS.

Filter on a double filter. a– Use 10 per cent. hydrochloric acid. b– Use 5 per cent. hydrochloric acid for washing.

SEVENTH STEP.

IGNITION AND WEIGHING.

Ignite wet in weighed platinum crucible until the barium sulphate is white.

MODIFICATIONS.

Dry filter and precipitate and ignite in a weighed porcelain crucible in a muffle.

Do not ignite at above a dull red heat.

Place filter paper in the crucible, apex upward.

Burn in an open crucible.

(*The chief danger in this step is the reduction of the sulphate by the burning filter paper and the decomposition of the sulphate if heated at too high a temperature.*)

Purifying the barium sulphate.

When necessary, as shown by a reddish tinge to the precipitate, the barium sulphate should be fused with sodium carbonate, dissolved in water, filtered, accidulated with hydrochloric acid, and precipitated with barium chloride.

(There is one other method in general use which did not fit into the outline and a brief description of it is appended.)

BAMBER'S METHOD.

Dissolve 5 grams, or the factor weight 6.878 grams of iron in strong nitric acid. Add 10 grams of sodium carbonate, wash into a platinum or porcelain dish, evaporate to dryness and ignite over an alcohol flame. Treat with water, with the addition of a little sodium carbonate, filter, wash with water containing sodium carbonate, acidulate the filtrate with a few drops of hydrochloric acid, evaporate to dryness, redissolve in water, add a few drops of hydrochloric acid, and precipitate the boiling solution with barium chloride.

ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETARY.

STANDARD METHODS FOR ANALYSING IRON.

PHOSPHORUS.

There are two general classes of methods in use for the determination of phosphorus in iron, viz., the long and short methods. The former would be impracticable as standard methods in general work except in instances where especially accurate phosphorus determinations are required. None of the methods submitted to me for editing gave a description of any of the long methods. When they were occasionally mentioned it was to refer to some standard authority. This outline, therefore, will consist chiefly of the so-called short methods for phosphorus analysis. The most used of the long methods are the Acetate method, the Molybdate method, and the Combination method. The Molybdate method forms the basis of most of the short methods. It is especially adapted for accurate work on account of the large weight of the molybdate precipitate in comparison to the weight of the phosphorus looked for, the molybdate precipitate weighing 63 times the contained phosphorus. This fact, perhaps more than any other renders the determination of the phosphorus in iron the easiest to check of any of the iron analyses.

There are three short methods in common use. The chief variation in them consists in the different methods of determining the amount of the phospho- molybdate precipitate. The permanganate titration is commended for steel analysis by the sub-commit-

tee on methods of the International Steel Standards Committee of the United States. Unfortunately several authorities state that it is not yet recommended for iron analysis. The Alkalimetric method introduced by Mr. J. O. Handy is in common use in iron works. It is somewhat shorter than the permanganate method. The direct weighing of the phospho-malybdate precipitate especially where Gooch crucibles are used, and an oven especially fitted up for quick drying, makes a method which is as short and perhaps as accurate as any of these methods.

OUTLINE.

THE CHARGE.

The amount taken for the charge in the methods examined varied from .4 of a gram to 5 grams. When the gravimetric method was used the charges were smaller than with the volumetric methods. Several grade their charges according to the amount of phosphorus suspected in the sample. The following are a representative of the weights taken for charges. .4075 grams (phosphorus runs between 2.25 and 2.50); 1 gram; 1 to 3 grams; 1 to 5 grams (according to the phosphorus suspected); 1.63 grams; 2 grams; 2.6 grams; 3 grams; 3.26 grams; 4 and 5 grams.

FIRST STEP.

Dissolving the sample. The following strengths and amounts of acids were used by different chemists.

a– 1.1 sp. gr. Nitric Acid.

60 c. c. for a 2 gram charge was used.
62 c. c. for a 2 gram charge was used.

b– 1.12 sp. gr. Nitric Acid.

30 c. c. for each gram charge was used.

c– 1.135 sp. gr. Nitric Acid.

50 c. c. for .4075 gram charge was used.
50 c. c. for 1 gram charge was used.
50 c. c. for 1.63 gram charge was used.
70 c. c. for a 2 gram charge was used.

75 c. c. for a 2 gram charge was used.
100 c. c. for a 2 gram charge was used.
100 c. c. for a 4 gram charge was used.

d– 1.20 sp. gr. Nitric Acid.
20 c. c. for 1 gram charge was used.
25 c. c. for a 1.63 gram charge was used.
80 c. c. for a 2 gram charge was used.
40 c. c. for a 3 gram charge was used.
50 c. c. for a 3 gram charge was used.
60 c. c. for a 3.26 gram charge was used.
30 c. c. for a 5 gram charge was used.
50 c. c. for a 5 gram charge was used.
60 c. c. for a 5 gram charge was used.
70 c. c. for a 5 gram charge was used.
75 c. c. for a 5 gram charge was used.

e– 2 parts Nitric Acid and 15 parts Water.
42 c. c. for a 2 gram charge was used.

f– Dissolve in sufficient nitric acid 1.20 sp. gr. add 20 c. c. of water and 5 drops of hydro-fluoric acid. (The hydrofluoric acid is said to dissolve the silica without interfering in any way with the precipitation of the phosphorus.)

The time allowed for the solution of the above, varied from a minute or two to three-quarters of an hour.

(The great variety in strengths and the amount of acid used is a very noticeable feature of the methods examined. As was mentioned under previous determinations, if the smallest amount of acid which could be safely and conveniently used was correctly determined, a great deal of time, not to say acids, would be saved. A large number used the more dilute acid. The 1.135 sp. gr. acid will completely dissolve the silica and is supposed to make the after procedure, especially the filtration, more expeditious than when the stronger acids are used. It apparently oxidizes the phosphorus just as successfully. The time allowed for the solution of the samples varied from 2 minutes to three quarters of an hour; the latter is probably excessive except in special cases. There is, however a tendency in all short methods to shorten the time allowed for the solution of the sample and many an error is laid to other causes which could be accounted for by the imperfect solution).

SECOND STEP.

Completing the oxidation and destroying carbonaceous matter.

A—By Evaporation to Dryness.

1. Evaporation and baking.

After the solution is complete evaporate to hard dryness.

MODIFICATIONS.

Evaporate to dryness and heat until all fumes escape.

Evaporate to dryness and bake one-half hour over free flame.

Evaporate to dryness and bake one-half hour at 200° C.

Evaporate to dryness and bake one hour at 200° C.

Evaporate to dryness and bake till residue curls up on side of dish.

Evaporate to dryness and bake five minutes.

Evaporate to dryness and heat porcelain container to redness.

Evaporate to dryness, after adding 1 gr. of potassium chlorate. Bake one-half hour.

Evaporate to dryness in porcelain dish, using inverted watch glass. Bake over free flame one hour.

Evaporate to dryness and bake only in case of chilled irons.

(The above evaporation to dryness is necessary for the complete precipitation of the phosphorus (except as shown under B.) Some state that this is to decompose the carbonaceous matter and that the latter prevents complete precipitation of the phosphorus. Others dispute this and state that the carbonaceous matter has little or nothing to do with the imperfect precipitation, but that simply dissolving the iron in dilute nitric acid is not sufficient to oxidize the whole of the phosphorus to the ortho form in which condition it must be, to be precipitated by ammonium molybdate. Still another states that if the solution is not evaporated and baked, a part of the phosphorus will remain as an insoluble iron phosphide instead of being oxidized to a phosphate. It is not definitely established how long or at how high a temperature it is necessary to bake the residue. The methods examined vary from simple evaporation to dryness to heating over a free flame for an hour. They agree without exception

that all white or chilled iron must be baked, and that wet oxidation (B) is not sufficient for complete precipitation in those irons.)

2. Solution of the oxidized residue.

Dissolve the residue in 20 c. c. concentrated hydrochloric acid (1.63 gram charge.)

MODIFICATIONS.

Dissolve in 15 c. c. hydrochloric acid (1.63 gram charge.)
Dissolve in 30 c. c. hydrochloric acid (3 gram charge.)
Dissolve in 30 c. c. hydrochloric acid (3.26 gram charge.)
Dissolve in 30 c. c. hydrochloric acid (4 gram charge.)
Dissolve in 15 c. c. H Cl. add 50 c. c. water (5 gram charge.)
Dissolve in 35 c. c. hydrochloric acid (5 gram charge.)
Dissolve in H Cl. add 8 to 10 drops hydrofluoric acid (4 gram charge.)
Dissolve in a few c.c. hydrochloric acid add 35 c. c. nitric acid.

3. Re-evaporation and solution.

NOTE.—This step is omitted by many who dilute the hydrochloric acid solution and neutralize directly as in Third Step.

Evaporate to dryness, take up in small amount of hydrochloric acid. Add nitric acid and boil till free from hydrochloric acid.

MODIFICATIONS.

Evaporate H Cl. solution to 4 c. c. and add 5 c. c. nitric acid.
Evaporate hydrochloric acid solution to 15 c. c.
Evaporate HCl. solution until it nearly sticks. Add 5 c.c. nitric.
Evaporate H Cl. solution to first appearance of ferric chloride. Then add 3 to 4 c. c. of nitric acid (1.63 gram charge.)
Evaporate H Cl. solution to first appearance of ferric chloride. Then add 20 to 30 c. c. nitric acid (3.26 gram charge.)
Evaporate H Cl. solution to first appearance of ferric chloride. Then add 5 to 10 c. c. nitric acid (5 gram charge.)
Evaporate hydrochloric acid solution to 10 c.c. and add 20 c.c. nitric acid.
Evaporate H Cl. solution until it becomes viscid. Add 5 c. c. nitric.

Evaporate H Cl. solution nearly to dryness. Add 30 c. c. nitric acid.

(There is a great difference in practice as shown in the above step. Some chemists claim that if the molybdate of phosphorus is to be weighed direct the hydrochloric acid must be re-evaporated to dryness to prevent the precipitation of the silica. Others claim that the silica will not be precipitated by the ammonium molybdate provided the solution is acid and there is not an excess of the ammonium chloride present. This second evaporation to dryness will also greatly facilitate the filtering off of the silica. The difference in opinion in regard to the amount of hydrochloric acid which should be left in the solution is shown by the difference in the amounts of hydrochloric acid left after the evaporation. It is now quite generally admitted that as long as the hydrochloric acid is finally neutralized by ammonia to ammonium chloride it helps rather than hinders the final molybdate precipitation. When the neutralization with ammonia is omitted, the hydrochloric acid should be completely removed by evaporation with nitric acid.)

4. Filter and wash the filter paper with dilute nitric acid allowing the filtrate to run into the receptacle in which the precipitation is to be made.

B—By Oxidation in the Wet Way.

1. Filter off the graphite and silica.
2. Boil off nitrous acid fumes.
3. Oxidize the solution.

a- Oxidize with potassium permanganate. Add concentrated potassium permanganate solution drop by drop until a permanent precipitate remains. Boil until all pink color disappears, which should take about 2 minutes.

MODIFICATIONS.

Add 10 c. c. potassium permanganate solution and boil, etc.

Add tartaric acid a little at a time until the solution clears. An excess should be avoided.

MODIFICATIONS.

Ferrous sulphate crystals, sugar, oxalic acid, ammonium oxy-

late, sulphurous acid, sodium thiosulphate or acid ammonium sulphate, may be used in place of the tartaric acid. One method added a little concentrated nitric acid to further clear up the solution after the addition of the tartaric acid. (The boiling is said to be essential in order to completely remove the nitrous acid fumes and complete the oxidation.)

b- Oxidize with chromic acid. 15 c. c. of chromic acid were used to oxidize the solution which was then boiled down to 15 c. c.

c- Oxidize with hydrochloric acid. 3½ c. c. hydrochloric acid were added for each gram charge taken, and the solution boiled.

(The potassium permanganate was much more frequently used. It is more effective and less liable to soil the phospho-molybdate precipitate than is the chromic acid. This method is said to fail to completely oxidize in case of chilled iron analysis, although one writer claims that iron with 3 per cent. combined carbon can be completely oxidized by sufficient boiling with potassium permanganate. Another states that 1 per cent. combined carbon is the limit for accuracy with this method. All are rather noncommittal as to the action of the permanganate upon the carbonaceous matter. Blair says that it completes the oxidation of the phosphorus in the iron and possibly neutralizes the effect of the carbonaceous matter.)

THIRD STEP.

Precipitation with ammonia and resolution in nitric acid.

NOTE.—When all the hydrochloric acid was removed by evaporation with nitric acid (Second Step A) this precipitation and resolution was generally omitted.

Precipitate all the iron in the solution with ammonia and then just dissolve the precipitate in nitric acid.

MODIFICATIONS.

Add 25 c. c. ammonia and 25 c. c. nitric acid which should leave the solution acid.

Add 25 c. c. ammonia and 28 c. c. nitric acid.

Add ammonia to a heavy precipitate and then nitric acid to a yellow color.

Add ammonia to a heavy precipitate and nitric acid to a dark amber color.

Different amounts of ammonia were added which were calculated from the charge and acid used to leave the solution acid without the further addition of nitric acid.

(The composition of the solution at this point may vary considerably and still have the precipitation in the next step complete. The time which is to be allowed for the precipitation of the phospho-molybdate determines the acidity of the solution. Phosphorus may be precipitated from a very strong nitric acid solution, but the presence ef the large excess of free acid is said to delay this precipitation. For rapid work the solution must be distinctly acid with nitric acid but not too much so, as such a solution gives low results. Insufficient acid however tends to give a reddish tinge to the precipitate due to the presence of basic nitrate of iron. Free hydrochloric acid must be avoided. It was formerly considered that all chlorides must be absent while now it is considered that with the exception of the hydrogen chloride, they aid the precipitation. Ammonium nitrate is an important factor in rapid precipitation.)

FOURTH STEP.

Precipitation with ammonium molybdate.

Heat to 40° C. add 40 c. c. molybdate solution at 40° C and stir on machine 10 minutes (1 gram charge.)

Heat to 40° C. add 50 c.c. molybdate solution at 40° C. shake 5 minutes (1.63 gram charge.)

Heat to 80° C. add 65 c. c. warm molybdate solution shake 5 minutes (2 gram charge.)

Heat to 85° C. add 45 c. c. molybdate solution at same temperature shake 5 minutes with a circular motion (2 gram charge.)

Heat to 90° C. add 65 c. c. molybdate solution and shake (2.6 gram charge.)

Heat to 75° C. add 40 c. c. molybdate solution shake a few seconds (4 grams Bessemer for charge.)

Heat to 75° C. add 75 c. c. molybdate solution shake 5 minutes (5 gram charge.)

Heat to 80° C. add 50 c. c. molydate solution shake 5 minutes (5 gram charge.)

Heat to 85 to 90° C. add 100 c. c. molybdate solution, shake 10 minutes.

The solutions were allowed to stand from barely time enough to settle to one-half hour in the short methods. The longer methods allow from 4 hours to over night for the precipitation of the phospho-molybdate.

(The apparent variation in the amounts of the molybdate solution used, per gram charge, is partially explained by the differences in the strength of the molybdate solutions. This by no means explains all of the variations, as many chemists using exactly the same solution differ greatly in the amount used. One writer states that the amount of molybdate should be 500 times the weight of the phosphorus in rapid precipitation. The temperature at which the precipitate can be made varies. Some keeping it below 40° to prevent the precipitation of arsenic should it be present while others aim to have the solution as hot as possible and not precipitate the molybdic acid and count any arsenic that may be precipitated as phosphorus.)

FIFTH STEP.

Filtering the precipitated phospho- molybdate.

Filter on a tared filter (for direct weighing of the precipitate.)

Filter on a weighed Gooch crucible (for direct weighing of the precipitate.)

Filter on a 9 c. m. filter.

Filter on a double filter.

SIXTH STEP.

Washing the precipitated phospho-molybdate.

Wash with 1 per cent. nitric acid solution.

MODIFICATIONS.

Wash with 2 per cent. nitric acid solution.

Wash with a dilute solution of ammonium sulphate.

Wash with 3 per cent. nitric acid and then with alcohol.

Wash with 1 per cent. nitric acid, then with .01 per cent. potassium nitrate.

Wash with 1 per cent. nitric acid, then with .1 per cent. potassium nitrate.

Wash with 1 per cent. nitric acid, with alcohol and ether.

Wash with 2 per cent. nitric acid and sodium nitrate solution till free from nitric acid.

Wash with 5 per cent. molybdate solution.

Wash with pure water.

SEVENTH STEP.

Determining the amount of the phospho-molybdate precipitate.

A—By direct weighing of the precipitate.

Dry the precipitate which has been filtered on a tared filter at 100° C. to constant weight. Weigh between watch glasses.

MODIFICATIONS.

Dry the precipitate on a weighed Gooch crucibie at 100° C. to constant weight.

Dry the precipitate at 110°, at 120°, at from 95° to 100°, to constant weight.

The precipitate which has been washed with alcohol and ether can be dried in three minutes at 110° C. if funnel is connected with an exhaust.

(The direct weighing of the precipitate, while it is open to the criticism that the precipitate is hydroscopic and that it sometimes varies in composition, gives very uniform results and for pig iron with medium and large percentages of phosphorus, is extremely accurate. The slight variation in weight, due to the hydroscopic nature of the phospho-molybdate, is insignificant when it is remembered that this precipitate is 63 times as heavy as its phosphorus content. The actual labor when a Gooch crucible is used is less than when the phosphorus is determined volumetrically and if a drying oven with exhaust is used the operation is no longer.)

B—By weighing the phosphorus as ammonium magnesium phosphate.

Some chemists still adhere to this method of weighing the phosphorus, and while it can hardly be called a short method, yet

judging from the methods received, it is in common use in many iron laboratories.

1. Dissolve the phospho-molybdate precipitate in dilute ammonia.

2. Make the solution slightly acid with hydrochloric acid.

MODIFICATIONS.

Add a drop of bromine after making solution acid.

3. Make ammoniacal. Heat to boiling and filter if necessary.

MODIFICATIONS.

Add a drop of citric acid solution after filtering.

4. Cool and add 10 c. c. magnesia mixture and 10 c. c. of ammonia.

MODIFICATIONS.

Add 10 c. c. magnesia mixture and 5 c. c. of ammonia.
Add 10 c. c. magnesia mixture and 3⅓ c. c. of ammonia.

5. Allow to stand in a cool place 1 hour.

MODIFICATIONS.

Different methods gave from 1 to 6 hours for this precipitation.

6. Filter and wash with 10 per cent ammonia solution.

MODIFICATIONS.

Use 5 per cent. ammonia, 1 to 3 ammonia, and dilute ammonia containing ammonium nitrate, for washing.

7. Burn wet and ignite at low heat over blast lamp.

MODIFICATIONS.

Ignite first at low heat over Bunsen lamp, then at highest heat of blast lamp.

8. Dissolve the precipitate in the crucible in nitric or hydrochloric acid, filter and wash residue, burn and weigh and the differ-

ence gives the weight of the magnesium pyrophosphate.

NOTE—Brearley & Ibbotson in their recent book give a method which they say can be completed in one-half hour and yet give a definite and easily manipulated compound for the final weighing, which can be ignited speedily without decomposition. The method is based on the following facts: To a solution containing molybdenum and phosphorus sufficient hydrochloric acid is added to prevent a precipitate when enough lead acetate is added to combine with the molybdic and phosphoric oxides. This mixture is added to another containing ammonium chloride and enough ammonium acetate to decompose the free hydrochloric acid, when a lead molybdate is precipitated and an acid lead phosphate held in solution. A factor deducted from the relation between the ammonium phospho- molybdane and the lead molybdate makes the calculation easy. The weighed lead molydate is over 140 times as heavy as the phosphorus being estimated, which makes the method very accurate. The details are as follows:

Proceed the same as the regular permanganate method up to the precipitation of the phospho-molybdate, dissolve the latter in a few drops of ammonia and filter. To the filtrate add 10 to 12 c. c. hydrochloric acid and 10 c. c. of lead acetate solution (40 grams to litre) and heat. Heat a mixture of 50 c. c. of ammonium chloride (200 grams per litre) and 50 c. c. strong ammonium acetate. Pour the former into the latter which is contained in a flask. Shake, filter, wash with hot water, ignite and weigh the lead molybdate. This weight multiplied by .007 gives the weight of the phosphorus in the iron.

(*This method is described with the thought that it might be of benefit to those who do not consider either the direct weighing or the titrating of the phospho-molybdate to be sufficiently accurate. It is certainly much shorter than the ammonium magnesium phosphate precipitation.*)

C—By titrating the molybdic acid in the phospho-molybdate precipitate.

1. Permanganate titration.

a– Solution of the phospho-molybdate precipitate.

Dissolve the phospho-molybdate precipitate on the filter in dilute ammonia water and allow it to run into a beaker, washing the filter with dilute ammonia.

b– Reduction.

Add 10 c. c. of strong sulphuric acid to the solution to be reduced. This heats the solution sufficiently by chemical action. Pass through a reducter which has been properly cleaned using the usual precautions to prevent oxidation, etc. This reduction takes about 4 minutes and the solution should be of a bright green color when finished.

MODIFICATIONS.

To the ammoniacal solution of the phospho.molybdate prdcipitate which is contained in a flask, add 5 grams of pulverized zinc and 15 c. c. of strong sulphuric acid. Close the flask with a stopper containing a bent tube which dips into a beaker containing a saturated solution of sodium bicarbonate. The flask should now stand one-half hour when all action should have ceased and the solution should be ready to filter and titrate. The solution should be of a green color and of a temperature of about 40° C.

c– Titration.

To the warm solution add standard permanganate solution drop by drop, shaking vigorously until a permanent pink color appears. A blank should be performed with the exact amount of reagents used, and the amount of permanganate used in titrating the blank be subtracted from the regular burette reading. This is generally higher with the flask reduction than when the reductor is used.

d– Calculation.

It has been found that the reduction with zinc in the flask is practically complete to molybdic acid, and hence the factor .88163 should be used. When the reductor is used the factor .85714 is used to allow for incomplete reduction.

[illegible]

[illegible]

[illegible]

Molybdic acid	c. c. Nitric acid	c. c. Ammonia	c. c. Water	Microcosmic salt
100 gr.	1000 (2 to 3)	80	400	50 gr.
100 "	1250 (1.20)	450	–	–
100 "	1500 "	100	200	–
100 "	600	400	500	–
100 "	600	400	600	–
100 "	395	155	1365	–
100 "	155	500	1330	–
150 "	1667 (1.20)	267	–	–
200 "	2500 "	500	–	–
200 "	2500	500	500	–
225 "	2500 "	400	600	–
453 "	2300	700	6000 (Woods .88 mixture)	
500 "	2300	700	6000	

The first solution is the one recommended by the International Steel Standards Committee of the United States (sub committee) for the permanganate method.

167

PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETARY.

STANDARD METHODS FOR ANALYSING IRON.

MANGANESE.

There are a greater variety of methods in common use for the estimation of manganese than for any other of the iron determinations. The principles upon which these methods are based are so different that no outline can cover all, and each method will be taken up separately. They may be divided into three distinct classes, the gravimetric, the volumetric and the color methods.

The gravimetric methods are the ones relied upon in all cases of dispute. There is probably no set of methods in which the personal equasion of the operator plays so important a part as in these manganese determinations. Any of the four or five different methods may produce good results in the hands of a chemist who has had a large experience with them, while in the hands of another, inexperienced with that special method, it becomes almost useless. Some of the short methods may, to one experienced in handling them, be more accurate than the so-called long methods with which he may not be familiar.

The acetate separation of iron and manganese is considered to be the most accurate method when carried out by one familiar with it. It is the most generally used in cases of dispute, but judging from the methods examined, it has but little application in general work. Ford's method is more generally used than any of the other gravimetric determinations and with careful attention to details is very accurate.

Acetate Method.

If one may judge from the statement of prominent authorities on iron analysis, a standardizing committee would have a great deal of difficulty in reconciling the differences of opinion in regard to this method. The acetate method as given in prominent American books is styled by a noted English chemist as "A series of chemical gymnastics," and he further states that an acetate precipitation in a 3 gram sample may be made in four hours. The method referred to attempts to avoid every possible error. If these errors are more imaginary than real and if the statement that four hours is sufficient to perform what now takes from 10 hours upward, it would appear that there was good field for standardizing work.

OUTLINE.

FIRST STEP.

Solution of the sample.

Dissolve 1 gram of the drillings in 15 c. c. nitric acid 1.20 sp. gr. Evaporate to dryness and bake. Re-dissolve in hydrochloric acid, evaporate to a syrup, dilute with water and filter.

MODIFICATIONS.

Dissolve 2.4 grams in a beaker with 450 c. c. graduate mark, in 50 c. c. fuming hydrochloric acid. Boil until all dissolves, add 3 c. c. of concentrated nitric acid, and make up to the 450 c.c. mark with hot water.

Dissolve 5 grams in sufficient hydrochloric acid, oxidize with a few c. c. nitric acid, and ditute with water.

(The variation in the method of solution is due to a difference of opinion as to whether a small amount of nitric acid will cause the manganese oxide to be precipitated with the iron in the following step. The solution in hydrochloric acid is said to exclude from the solution the carbonaceous matter which has a tendency, when dissolved in nitric acid, to prevent the precipitation of some of the iron. The difference in time between the method and the modification is quite marked.)

SECOND STEP.

Neutralizing the solution.

Add sodium carbonate until a very slight precipitate remains and dissolve this in as few drops of hydrochloric acid as possible.

MODIFICATIONS.

Add ammonia water, a little at a time, until a very slight precipitate or turbidity remains.

Neutralize as far as possible with ammonia without forming a permanent precipitate.

THIRD STEP.

Separating the iron from the manganese.

Add 2 grams of sodium acetate in water, dilute to 700 c. c. with boiling water, boil 10 minutes, filter and wash by decantation, re-dissolve precipitate on the filter in 10 c. c. hydrochloric acid, and re-precipitate. Repeat this re-solution and re-precipitation and collect three filtrates.

MODIFICATIONS.

Heat to boiling and precipitate with ammonium acetate solution. Make up to the mark in a litre flask and filter off 500 c. c. into another graduated flask.

Add 50 c. c. of cold ammonium acetate solution with constant stirring (2.4 gr. charge). Heat to boiling and boil 2 minutes with constant stirring. Pour all into a flask graduated at 605 c. c. Mix well and note temperature with thermometer. Filter to a 500 c. c. graduated flask, heat to the same temperature as when in the 605 c. c. flask and make up to the mark. (The extra 5 c. c. is for a correction for the volume of the precipitate itself and for the slight evaporation of the solution between the measurings.)

(The great difference in the time between the original method and the modification will be noted. The former makes three precipitations and washing of a very bulky precipitate, while the modifications do neither. The disagreement on the question as to whether manganese is precipitated with the iron in the acetate precipitation is the cause for this difference in procedure. One states that the re-solution and precipitation is a

waste of time unless enough acetate has been added to precipitate many times the amount of iron present. A series of determinations taken from "Arnold's Steel Works Analysis" give the following results from a single and double precipitation:

Single precipitation	.684	.745	.710	.634	.644	1.364
Double precipitation	.684	.763	.710	.634	.655	1.357
Difference	.000	.019	.000	.000	.011	.007

It will be noted that the method given as the original used the sodium salt for the precipitation while the modifications used the ammonium salt. It was formerly believed that the presence of ammonium salts prevented the precipitation of the manganese by bromine. This is now known to be untrue and the ammonium salts are said to possess advantages over the sodium salts, especially if the manganese is to be weighed directly as manganese dioxide, in which case it is very difficult to wash the precipitate free from fixed alkali.)

FOURTH STEP.

Evaporation, and precipitation of copper, cobalt and nickel (if present).

Evaporate the filtrates to 300 c. c. Add 10 grams sodium acetote and a few drops of acetic acid and pass hydrogen sulphide gas through the boiling solution for 10 minutes. Filter off the precipitate and boil the Hydrogen Sulphide from the filtrate.

MODIFICATIONS.

Boil the filtrate briskly down to 250 c. c. in order to precipitate any iron which may have remained in solution with the manganese.

(Some state that it is more difficult to insure complete precipitation of the iron than it is to prevent the precipitation of the manganese with the iron. The boiling down to 250 c. c. is said to throw out any such iron. The precipitatian with hydrogen sulphide is very generally omitted in pig and cast iron analysis.)

FIFTH STEP.

Precipitating the manganese.

Add bromine water in excess and until the solution is fully col-

ored by it. Allow to stand from 1 to 2 hours. Boil off the excess of bromine, filter off the precipitate and wash. Dissolve the precipitate on the filter in sulphurous acid water containing a little hydrochloric acid. Boil off the sulphurous acid and precipitate the manganese with microcosmic salt, adding ammonia water slowly with constant stirring until no further precipitation occurs and the precipitate is all crystalized. Filter, wash with ammoniacal solution of ammonium nitrate, ignite and weigh as manganese pyrophosphate.

MODIFICATIONS.

Add 4 c. c. pure bromine, then 30 c. c. ammonia, and heat until the liquid is clear. Filter, wash with hot water, ignite strongly in a muffle in platinum crucible for 15 minutes without lid and weigh as manganese oxide.

Add a few c. c. of bromine and just enough ammonia to give a distinct odor to the solution, but no more.

Use 1 per cent. hydrochloric acid or very dilute nitric acid for washing the manganese oxide.

In case of great accuracy, the manganese oxide precipitate should be tested for iron.

(The weighing of the manganese oxide is said to give rise to error due to the difference in composition of that precipitate after ignition. This is especially true when ignited in a free flame in platinum crucible. The reducing gases of the flame preventing complete oxidation. The use of a muffle for burning the precipitate is said to overcome this and to render the composition of the oxide very exact. The use of the pyrophosphate weighing arose from the belief that the composition of the manganese oxide was not constant.)

Chlorate Method.

(Including Ford's and Williams' and a combination of the two.)

This method is more used than any other gravimetric method in iron laboratories in the United States. Its advantage over the acetate method consists in the large samples which may be handled and the time saved. The only error inherent in the method is due to the variation in composition of the manganese dioxide precipitate. This error has been overcome by weighing the manganese

as a pyrophosphate, or by dissolving the manganese dioxide precipitate and titrating.

OUTLINE.

FIRST STEP.

Solution of the sample.

Dissolve 5 grams of the sample in 60 c. c. nitric acid, 1.20 sp. gr. and evaporate until the solution is almost syrupy.

MODIFICATIONS.

Dissolve 5 grams of the sample in 150 c. c. nitric acid, 1.20 sp. gr. and evaporate to 100 c. c. Add 50 c. c. concentrated nitric acid and evaporate to 100 c. c.

Dissolve 2 to 5 grams in the least possible amount of nitric acid 1.20 sp. gr. and evaporate to the separation of the ferric nitrate.

Dissolve 3 to 5 grams in 50 c. c. nitric acid 1.20, evaporate and bake 5 minutes. Dissolve in hydrochloric acid and evaporate off the hydrochloric acid with concentrated nitric acid.

Dissolve 5 grams in 60 c. c. nitric acid 1.20 sp. gr. evaporate to hard dryness, take up in hydrochloric acid, evaporate to viscid solution, add 5 c. c. nitric acid, dilute, filter, add 40 c. c. concentrated nitric acid, evaporate to pasty condition, add 40 c. c. concentrated nitric acid, and again evaporate to pasty condition.

Dissolve 3 grams in 50 c. c. nitric acid, 1.20 sp. gr.

Dissolve 1½ gr. in 75 c.c. nitric acid 1.20 sp.gr. and add a few drops of hydrofluoric acid.

Dissolve the sample in hydrochloric acid, evaporate to dryness add 75 c. c. nitric acid and evaporate off all hydrochloric acid.

Dissolve 1 gram in 20 c. c. hydrochloric acid. Evaporate to dryness, take up in hydrochloric acid, evaporate nearly to dryness, add 60 c. c. concentrated nitric acid and evaporate to a syrup.

Dissolve 5 grams in 60 c. c. nitric acid, add a few drops of hydrofluoric acid and evaporate to a syrup.

(The variation in this step is due to an attempt to obtain the silica in a condition suitable for easy filtration. The addition of a few drops of hydrofluoric acid to the nitric acid solution before evaporation is said to accomplish this without harm to the rest of the determination. If this

could be proved true, the process would be shortened for many chemists who take the time to go through several evaporations. The destroying of the carbonaceous matter is dwelt on by a few but the majority do not consider it necessary.

SECOND STEP.

Precipitation with potassium chlorate.

Add 50 c. c. concentrated nitric acid and 5 grams of potassium chlorate. Boil 15 minutes, again add 50 c. c. nitric acid and 5 grams of potassium chlorate and boil 15 minutes and cool in water.

MODIFICATIONS.

Add 75 c. c. concentrated nitric acid, boil, add an excess of potassium chlorate a little at a time, and boil a few minutes after the fumes are all gone.

Add 100 c. c. concentrated nitric acid and boil. Add 5 grams of potassium chlorate and boil 10 minutes.

(X) Add 3 grams potassium chlorate (1.5 gr. charge in 75 c. c. nitric acid and 5 drops of H F) boil, add 1 gram potassium chlorate and boil.

(The composition of this precipitate is not sufficiently constant to allow a direct filtering and weighing. It is contaminated with basic iron and potash salts.)

THIRD STEP.

Filtration of the manganese oxide.

Filter rapidly on a pulp or asbestos filter with suction. Wash two or three times with concentrated nitric acid, then with cold water and suck dry.

(X) In the modification marked (X) second step the filtration was omitted and the precipitate oxidized and titrated in solution. (See (X) B fourth step.

FOURTH STEP.

Estimation of the manganese oxide.

The method may be carried on from here as a gravimetric or a volumetric process.

A—GRAVIMETRIC. Estimation of the manganese dioxide.

a– Solution of the manganese dioxide precipitate. Transfer the washed precipitate and filter to a beaker and add 10 to 40 c. c. strong sulphurous acid water, washing out the funnel with the same. Filter off the asbestos and boil off the sulphurous acid fumes.

MODIFICATIONS.

Dissolve the precipitate in concentrated hydrochloric acid, rinsing out the funnel with the same, filter off the asbestos, washing the filter with water.

b– Precipitation of the iron.

Add bromine water until the solution is strongly colored by it. Boil off the excess of bromine and add ammonia until the solution smells strongly of it. Boil and filter and wash the precipitate with water. Dissolve the precipitate in hydrochloric acid (1 to 3) and re-precipitate with ammonia. Repeat the precipitation etc., and allow the three filtrates to run into one beaker.

MODIFICATIONS.

Precipitate the iron with ammonium acetate as in Acetate Method, repeating the solution in hydrochloric acid and precipitation with ammonia once.

Precipitate the iron with ammonia, making it just alkaline, then faintly acid with acetic acid and boil. (One precipitation being sufficient.)

(The same disagreement exists here as was mentioned in the Acetate Method. Some claim that the small amount of iron contained in the precipitate thrown down by the chlorate could not carry down an appreciable amount of manganese, while others insist on carrying out the three separations.)

c Precipitating the manganese.

Precipitate with microcosmic salt and weigh as manganese pyrophosphate as given under Acetate Method, fifth step.

MODIFICATIONS.

Precipitate the manganese as oxide with bromine, filter, ignite and weigh as given under Acetate Method, fifth step Modification.

B—VOLUMETRIC. Estimation of the manganese dioxide.

Dissolve the manganese dioxide precipitate obtained in third step in 100 c. c. standard ferrous sulphate solution and titrate the excess of ferrous sulphate with potassium permanganate.

MODIFICATIONS.

Titrate the excess with standard potassium bichromate solution.

Dissolve the precipitate in hydrogen peroxide solution and titrate with potassium permanganate.

Dissolve the precipitate in sufficient amount of a mixture of 50 c. c. hydrogen peroxide, 50 c. c. sulphuric acid and 1000 c. c. of water and titrate with potassium permanganate.

(X) Add to the solution (see third step, Modification X) sufficient hydrogen peroxide solution from a pipette to dissolve the manganese dioxide and titrate the excess with potassium permanganate.

This last modification is a part of a method which shows the great difference in time allotted to this determination by different chemists. The following is quoted in order to give an example of how much this process has been modified. "1½ gr. of drillings are weighed into a No. 3 beaker. 75 c. c. nitric acid and 5 or 6 drops of hydrofluoric acid added, heated to boiling on the hot plate and when all is in solution, add about 3 grams potassium chlorate, boil 5 minutes, and add about 1 gram potassium chlorate, boil to expel fumes from the chlorate. Cool in cold water, fill the beaker ¾ full of water, add enough hydrogen peroxide solution from a pipette to dissolve the oxide of manganese, and titrate the excess with standard permanganate solution." This is without exception the shortest Ford's method examined.

Volhard's Method

This method is in very common use and is considered accurate by a great many chemists. The method may be modified into an

extremely rapid method for irons low in combined carbon. Irons high in combined carbon must have their carbonaceous matter destroyed which lengthens the method considerably.

OUTLINE

FIRST STEP.

Solution of sample and destroying carbonaceous matter.

Dissolve 1.5 grams of sample in 25 c. c. nitric acid, 1.20 sp. gr. and when the solution is complete add 12 c. c. sulphuric acid (1 to 1) evaporate to fumes and dissolve in water.

MODIFICATIONS.

Dissolve 1.5 grams in 25 c. c. nitric acid 1.20 sp. gr. evaporate to dryness and bake, dissolve in 15 c. c hydrochloric acid, add 12 c. c. sulphuric acid, evaporate to fumes and dissolve in water.

Dissolve 2 grams in 40 c. c. nitric acid 1.20 and boil off nitrogen dioxide fumes.

Dissolve 1 gram in 25 c. c. nitric acid 1.20 sp. gr. and evaporate to 10 c. c.

Dissolve 1 gram in 40 c. c. nitric acid, evaporate nearly to dryness and take up with water.

Dissolve 2 grams in 60 c. c. nitric acid 1.13 sp. gr. and evaporate just to separation of ferric nitrate.

Dissolve 1 gram in silicon mixture and evaporate 2 minutes after sulphurous acid fumes begin to come off.

Dissolve 2 grams in 40 c. c. nitric acid 1.20 sp. gr. for soft iron; in nitric acid and sulphuric and evaporate to fumes for hard iron, in nitric acid, evaporate, bake, dissolve in hydrochloric, add sulphuric and evaporate to fumes for chilled iron.

(The chief points to be noted in the solution of the sample is to have the carbonaceous matter destroyed in high combined carbon iron, and when this is not necessary, to make sure that the nitrogen dioxide fumes are expelled by boiling. Some consider that sulphuric acid gives a more marked end point in titrating and so invariably use it even when there is no necessity for evaporation to destroy the carbonaceous matter.

SECOND STEP.

Precipitation of the iron.

Transfer the solution of iron into a 300 c. c. graduate flask. Nearly neutralize the solution with sodium carbonate and then add zinc oxide suspended in water with shaking until the solution coagulates.

MODIFICATIONS.

Transfer the solution to a 500 c. c. graduated flask, add a weighed amount of zinc oxide in water until the solution just coagulates, dilute the solution to about 400 c. c., shake, and then add the remainder of the zinc oxide.

Transfer the solution to a 500 c. c. graduated flask and add zinc oxide to slight excess.

Transfer the solution to a litre flask, dilute to 500 c. c., add zinc oxide until all the iron is precipitated.

To the sulphate solution contained in the beaker or dish in which the solution was made, add dry zinc oxide until all the iron is precipitated, add one-half gram in excess.

(It is claimed by some that zinc oxide in large excess is liable to take down manganese. This may be overcome by just neutralizing with the zinc oxide. Then dilute to large volume, and add the excess of zinc oxide. The addition of a fixed amount af zinc oxide is to be recommended when a part of the whole volume is taken for titration. The same amount of zinc oxide is used in a determination on a sample of iron whose manganese has been determined gravimetrically. This throws out the error due to the fact that when only a part is taken for titration, all the zinc oxide and iron precipitate are left in the portion not taken. This makes the portion titrated proportionally higher in manganese. When the whole is titrated, as in the last modification, this does not apply.)

THIRD STEP.

Preparation for titration.

Make the solution in the 300 c. c. graduated flask up to the mark, mix thoroughly, allow to settle, and filter off exactly 200 c. c. of the clear portion.

MODIFICATIONS.

Make the solution in a 500 c. c. flask up to the mark, and take from 50 to 300 c. c., according to the per cent. of the manganese suspected in the sample.

Make the solution in a 500 c. c. flask up to the mark, draw off 250 c. c. and boil 5 minutes.

Make the solution in a litre flask up to the mark and take 500 c. c. for titration.

(In an unknown sample, it is well to draw off 50 c. c. of the solution and make a rapid titration in order to get an idea of how much of the solution it is best to take and thus facilitate the addition of potassium permanganate. A rapid titration is always the most satisfactory.)

FOURTH STEP.

Titration.

Heat the solution to boiling, add 2 drops nitric acid 1.20 sp. gr., then add standard permanganate solution until all the manganese is precipitated and a permanent pink color remains. The solution should be kept hot during titration.

MODIFICATIONS.

The addition of the nitric acid is very generally omitted.

STANDARDIZING THE PERMANGANATE SOLUTION.

1. Standardize against standard ferrous sulphate solution.

When the solution is standardized in this manner a blank determination should be performed and the amount taken to produce a pink color be subtracted from the burette reading.

(This method is inaccurate when a part of the solution is taken for the titration on account of the error due to the zinc oxide and the iron being left in the part not titrated.)

2. Standardize against a gravimetric standardized sample of iron. This is the more accurate especially in determinations where a part of the whole solution is taken for titration. If an exact

amount of zinc oxide is used in the standardizing and in the determination, the method is very accurate. When the whole amount of the precipitate and zinc oxide is included in the amount titrated, the method of standardizing does not make as much difference.

Deshay's Method

This method is quite extensively used for steel analysis, but its application to cast iron is limited. Some chemists, however, still adhere to it. It is more accurate for low manganese samples than for high manganese. The accuracy decreases as the per cent. of the manganese in the solution increases. It is inapplicable to iron containing cromium when ferrous sulphate is used for titration. In such irons ammonium oxalate is said to give satisfactory results. The chief advantage of the method consists in the fact that a large number of determinations may be carried on simultaneously.

OUTLINE

FIRST STEP.

Solution of the sample.

Dissolve 0.5 gram of drillings in 30 c. c. nitric acid 1.20 sp. gr. Boil until solution is complete and nitrogen dioxide all expelled.

MODIFICATIONS.

Dissolve 0.2 gram in 50 c. c. nitric acid 1.20, and boil off nitrogen dioxide.

Dissolve 0.05 to 0.1 gram, according to the per cent. of manganese, in nitric acid 1.20 sp. gr.

SECOND STEP.

Oxidation of the manganese.

Add 1 to 3 grams of red lead and dilute to 60 c. c. with hot water. Heat to boiling.

MODIFICATIONS.

Add red lead until pink color becomes cloudy, boil 1 minute.

Add 0.5 gram red lead, boil 4 minutes, transfer to a wide mouthed 4-oz. bottle, and place in centrifugal machine and rotate 2 minutes. At the end of that time the lead oxide will be compact in the bottom of the bottle.

THIRD STEP.

Preparation for titration.

Allow the solution to settle and decant off the liquid through an asbestos filter. Boil residue with 50 c. c. nitric acid (1 to 3), decant, and repeat operation until decantations are colorless.

MODIFICATIONS.

Filter the solution immediately through asbestos filter.

When the centrifugal machine is used, the liquid is simply poured off and is ready for titration.

(*The chief variation in this step is the method used in washing the residue free from permanganate. Some consider that if the standard is treated the same as the determination a complete washing of the residue is unnecessary. Others state that the method is inaccurate unless the permanganate is completely washed out of the lead oxide residue.*)

FOURTH STEP.

Titrating the solution.

Titrate with sodium arsenite solution until the pink color just disappears.

MODIFICATIONS.

Titrate with standard ferrous sulphate solution, or add excess of standard ferrous sulphate, and titrate back with standard potassium permanganate solution.

Color Method

(*This method has, like the previous one, been more used for steel than for cast iron. Judging from the methods examined, a considerable number now use it for iron. The red lead oxidation has been superceded by the persulphate and silver nitrate oxidization in many laboratories. The method is more accurate for low manganese irons.*

OUTLINE.

FIRST STEP.

Solution of the sample.

Dissolve 0.2 gram in an 8 in. test tube in 15 c. c. nitric acid 1.20 sp. gr. Place in a bath and heat at 100° c. until the solution is complete.

MODIFICATIONS.

Dissolve 0.2 gram in 20 c. c. nitric acid 1.20 and boil 5 minutes.

Dissolve 0.2 gram in 30 c. c. nitric acid 1.20 sp. gr. boil until fumes are all gone.

Dissolve 0.2 gram in 50 c. c. nitric acid 1.10 sp. gr.

Dissolve 0.1 gram in 30 c. c. nitric acid 1.13 sp. gr. heat at 120 deg. in calcium chloride bath.

Dissolve 0.1 gram in 35 c. c. 32 per cent. nitric acid and boil until fumes are all gone.

Dissolve 0.1 gram in 10 c. c. nitric acid 1.20 sp. gr. heat at 140° c. to the expulsion of nitrogen dioxide fumes.

Dissolve 0.5 gram in 40 c. c. nitric acid 1.20 sp. gr.

(The variation in the amount and strength of acid and in the temperature of heating are the chief differences observed. A standard is almost invariably carried along with the determination.)

SECOND STEP.

Taking a fractional part for oxidation.

Transfer the dissolved sample into a graduated tube and make up to 100 c. c. and mix thoroughly. Draw out exactly 10 c. c. for the determination. Run into a test tube and add 3 c. c. nitric acid 1.20 sp. gr.

MODIFICATIONS.

Draw off 25 c. c. and add 6 c. c. nitric acid 1.20.

Transfer to a 50 c. c. graduated tube, make up to the mark, draw off 10 c. c. add 3 c. c. nitric acid 1.20 sp. gr.

Draw off 10 c. c. and add 5 c. c. nitric acid 1.20 sp. gr.

(This step is very generally omitted and the whole amount is oxidized.)

THIRD STEP.

Oxidizing the solution.

A—With lead oxide.

Heat the solution in the test tube to boiling and add 0.5 gram of fine lead oxide. Boil 5 minutes, cool in cold water in the dark and allow to settle.

MODIFICATIONS.

Add 1 gram of lead peroxide and boil 2 minutes. Cool and allow to settle in the dark.

Add 0.2 to 0.5 gram of lead oxide and boil 3 to 4 minutes.

Add 0.2 gram of lead oxide and boil 30 minutes.

B—With ammonium persulphate and silver nitrate.

(1 gram charge was taken, dissolved in 30 c. c. nitric acid 1.20 made up to 100 c. c. and 10 to 20 c. c. taken according to the per cent. of the manganese.)

The solution in the test tube is warmed and a little ammonium persulphate added and then 5 c. c. silver nitrate solution. (1 gram in 250 c. c.) then add a little more ammonium persulphate.

MODIFICATIONS.

(0.1 gram was dissolved in a test tube in 10 c. c. nitric acid 1.20).

Add to the solution in the test tube 15 c. c. silver nitrate solution (1.33 grams to a litre) and 1 gram of ammonium sulphate crystals and heat in water bath till a good pink color is formed, then place in cold water to prevent further action.

FOURTH STEP.

Comparison of colors.

Decant the oxidized solution into comparison tubes and compare the determination with the standard which has been carried through under exactly the same circumstances. Dilute the sample until it is exactly the same color as the standard, or vice-versa, and a calculation is made taking into account the amount of the original solution used.

MODIFICATIONS.

A permanganate solution of known strength is occasionally used in place of standard.

(The standard and sample must be of nearly the same per cent. of manganese in order to obtain good results. The variations in treatment etc. are counteracted, provided that these are performed at the same time on the standard and the standard is of the same kind of iron as the sample under analysis. The use of a permanganate solution as a standard is open to many objections.)

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETARY.

STANDARD METHODS FOR ANALYSING IRON.

TOTAL CARBON.

The work of the American members of the International Steel Standards Committee should relieve our Association of any work on this subject. I should not feel it necessary to even outline these methods if it were not for the fact that many still adhere to the methods which have been pronounced inaccurate by the highest authorstics on iron analysis. Many of the methods examined estimate the combined carbon in iron by color, and the graphitic carbon by direct weighing, and add these two together and call the sum, total carbon. Both of these methods are open to decided objections, and contain errors which cannot be avoided. The combination of the two results makes the total carbon obtained little more than guess work. The determination of carbon in iron, especially in grey iron, is a difficult matter under the best of conditions. It is difficult to obtain uniform samples from drillings high in graphitic carbon, owing to the tendency of the graphite to remain in the finer portions of the sample. The practice of moistening the whole sample with alcohol and then selecting the portion used for the determination, is said to partly obviate this difficulty. When an extremely accurate analysis of pig or cast iron is desired, the best method is to drill a certain amount of the sample and use the whole amount drilled for the carbon determination.

Numerous methods for the separating and estimating the car-

bon have been used with various degrees of accuracy. The methods under consideration at present are those which would form suitable standard methods for analysis of iron in every-day laboratory work. Objections have been raised to every method proposed for the estimation of total carbon in iron. The American Steel Standard Committee advocated the use of an acid potassium chloride solution for the solution of the drillings in the face of statements made by some of the most prominent chemists in the world, that carbon could not fail to be evolved as gas when so treated. What is first desired is accuracy, and next to accuracy is uniformity in results by chemists in general. The method which will give the greatest degree of accuracy in the hands of the greatest number of chemists, even if it be open to a single theoretical objection, is far superior to methods which go through so much red tape that the errors due to manipulation more than exceed the errors which they are supposed to eliminate.

All the methods examined for the determination of the total carbon in iron sent in by the different chemists in response to the call of the standardizing committee, separated the iron from the carbon by an acid solution of copper potassium chloride. The methods of estimating the separated carbon varied considerably. Some oxidized it in a porcelain or platinum tube, others in a special crucible, while still others used the sulphuric and chromic acid methods.

Blair gives a method which is used abroad, viz., the solution and oxidization of the borings in sulphuric, chromic and phosphoric acids, and direct weighing or measuring of the evolved carbon dioxide gas. This method has received comparatively little application here, although it is very favorably spoken of by foreign chemists. Many of our chemists who insist upon using the wet method for oxidation of the carbon, which has been separated by the copper potassium chloride method, might do well to substitute this method which greatly shortens the time for the determination and is said to be open to no objections not experienced in the combustion of the separated carbon in the wet way.

OUTLINE.

As was mentioned in the introduction, the methods in general

use in the United States, separate the iron and carbon by an acid copper potassium chloride solution. The only difference noted in the method examined, was the amount and the acidity of the solution used and the time of adding the acid. Some dissolved the iron in a neutral solution and added the acid just before filtering the carbon. The majority, however, added the hydrochloric acid to the copper potassium chloride solution just before adding the latter to the drillings.

Copper Potassium Chloride Solutions.

The following are typical of the copper potassium chloride solutions used.

300 grams per litre and add 5 per cent. hydrochloric acid when used.

453 grams to litre, filter through asbestos, and add 50 c. c. hydrochloric acid to the litre.

378 grams to litre, filter through paper, then asbestos, and add 5 per cent. hydrochloric acid when used.

346 grams to litre, filter through asbestos, add ammonia to a slight precipitate, add 5 per cent. hydrochloric acid when used.

A saturated solution, add 7½ per cent. hydrochloric acid when used.

FIRST STEP.

Separation of carbon from the iron.

Dissolve 1 gram of drillings in 100 c. c. saturated solution of copper potassium chloride and 7.5 c. c. hydrochloric acid. Stir constantly, preferably on stirring machine, temperature not to exceed 60° or 70°, until copper is all dissolved.

MODIFICATIONS.

Dissolve 1 gram in 100 c. c. copper potassium chloride, and add 5 c. c. hydrochloric acid just before filtering.

Dissolve by stirring on machine at temperature of the room.

Dissolve by shaking one hour on revolving board, at temperature of the room.

Dissolve 1 gram in 100 c. c. and add 10 c. c. hydrochloric acid, at a temperature of 70° C.

Dissolve 1 gram in 150 c. c. of acid copper potassium chloride.

Dissolve 1 gram in copper sulphate (1 to 5 solution). When all iron is dissolved add 16 c. c. of cupric chloride solution (1 to 2), and 12 c. c. hydrochloric acid and warm until the copper is dissolved.

(The chief variations in this set consist in the acidity of the solution and the temperature at which the solution should be heated. The acid solution gives higher results than the neutral solution. This may be due to the fact that the neutral solution fails to decompose some carbon and iron existing in a condition which is not decomposed at the temperature of the ignition furnace. It might be due to either evolution of hydro-carbons or the slight solubility of the carbonaceous matter in the neutral solution. It has been proven that there is an evolution of hydro-carbons when the solution is heated above 70° C.)

SECOND STEP.

Filtration.

Filter on a platinum boat or tube and wash with 10 c. c. dilute hydrochloric acid and then with hot water until free from acid.

MODIFICATIONS.

Filter on a porcelain boat, wash with acid and water.

Filter on a glass filtering tube, with a porcelain disc, wash with hydrochloric acid, and then with water, and for irons containing Tungsten or Chromium, with water only.

Filter on a Gooch crucible, wash with hydrochloric and hot water.

Filter on a Gooch crucible and wash with water.

Filter on specially prepared asbestos filter.

The three last modifications are for use in the Schimer combustion crucible.

(The degree of washing depends upon the precautions taken in the absorption train for taking up any chlorine or hydrochloric acid gas.)

THIRD STEP.

Drying the residue.

Dry at 100° C in an air bath.
Dry at 110° C in an air bath.
Dry at 90° C for one hour.
Dry at 85° C.

(The difference in temperatures used for drying arise from the fact that some chemists have claimed that the carbon residue containing moist oxygen gas, gives rise to carbon dioxide gas when heated to 100° C.)

FOURTH STEP.

Burning of the carbon.

A.—APPARATUS.

1. Porcelain combustion tube.

Fill the forward end of a 25 inch porcelain combustion tube with 6 in. copper wire gauze, in a finely wound coil which has been heated for one hour in oxygen. Next to this place a piece of sheet silver rolled up to fit the bore and follow with the boat. Finally insert another coil of copper gauze.

MODIFICATIONS. (Job & Davies)

A 20-inch Berlin porcelain tube, ¾ in. inside diameter, is fitted same as above, omitting the sheet silver. A piece of platinum foil as long as the boat lines the inside of the tube where the boat rests. The apparatus is so arranged that the boats may be put in and taken out without cooling off the tube.

2. Platinum Combustion Tube.

Fill the forward end of the platinum tube with a coil of platinum gauze. Then insert 6 inches of granular copper oxide, followed by another coil of platinum gauze. The boat comes next and then a coil of platinum gauze.

3. Combustion crucible. (Shimer)

This is a water-jacketed platinum crucible and should be fol-

lowed by a small porcelain or brass tube containing granular copper oxide. The jacketed top may be removed and the carbon is inserted in the crucible either in a Gooch or specially prepared asbestos crucible.

4. Flask for Chromic Acid Combustion.

This is a flat bottom flask containing a two hole rubber stopper through which passes a funnel tube and an outlet tube.

(The apparatus used in burning off the carbon is a large factor in determining the speed and accuracy of the determination. The large platinum and porcelain tubes require a longer time for the combustion and for heating and cooling of the tubes. This is especially true with the porcelain tubes which are liable to crack. The apparatus of Job and Davies, which keeps the tube hot all the time overcomes this difficulty and allows a large number of determinations to be performed in one tube in a day. The Shimer combustion crucible greatly simplifies this part of the apparatus. It requires but one burner and a very small amount of space. With a good blast lamp and by the use of oxygen this apparatus admits of very rapid combustion.)

B.—PURIFYING THE OXYGEN AND AIR.

Use a bulb filled with caustic potash solution, followed by a U tube, the first side of which is filled with dry pumice and the other with calcium chloride.

MODIFICATIONS.

Use a bulb filled with caustic potash solution, followed by an empty tube.

Use a tube filled with fused caustic potash.

Use a bulb filled with caustic potash solution, followed by a tube containing solid caustic potash.

Use a soda-lime tube. Pass the oxygen first over red hot copper oxide, then through a bulb containing caustic potash solution and a tube containing granular calcium chloride and soda lime.

(A furnace and tube for oxidizing any carbon compound in the oxygen and air, to Carbon dioxide, so that it may be absorbed by

the purifying train is in use in a few laboratories. It is not generally considered necessary.)

C.—Combustion of the Carbon.

Burn out the apparatus until no increase in weight is found in the absorption tubes. Place the boat in the tube and start a current of oxygen through the apparatus. Light burners under the copper gauze first, then the rest of the burners in succession. Heat ten minutes after all are lighted. If a platinum tube, it should not be heated over a low red. Cool gradually, and draw or force 1 litre of air through while cooling.

MODIFICATIONS.

Fifteen minutes are allowed in a porcelain tube for combustion of the carbon after the tube is hot.

(Job & Davies. See Apparatus.)

Seven minutes are allowed for combustion. The tube is always hot after the first combustion. Then pass air through for 12 minutes at 6 to 7 bubbles per second.

Ten minutes are allowed for combustion in a 10 burner porcelain tube furnace. Pass air through for ten minutes.

If a ten burner furnace with porcelain tube, ten minutes are allowed for heating up, fifteen minutes for combustion, and thirty minutes for passing air.

In a ten burner furnace fifteen to twenty minutes are allowed for combustion after the tube is hot. Air is drawn through for forty-five minutes.

One hour is allowed for combustion in a porcelain tube. Air only is used.

Burn in a Shimer combustion crucible, using air only, with a blast lamp, twenty five minutes is allowed for the combustion of the carbon. When oxygen is used, 10 to 15 minutes is sufficient for combustion and 5 to 15 minutes are allowed to drive out oxygen.

Burn in a Shimer combustion crucible placing a perforated disc of platinum on top of the carbon, then fill the crucible nearly full with ignited asbestos. In this manner a Bunsen lamp without blast is sufficient.

Transfer carbon together with asbestos on which it was filtered

into a flask and burn off the carbon with sulphuric acid and chromic acid. 10 c. c. saturated chromic acid solution and 100 c. c. hot sulphuric acid being used.

(The wet and dry methods are both in common use in iron laboratories. The wet method claims an advantage in time in not having to wait to dry the carbon residue before combustion and in the expense over tubes, especiallly if platinum is used. Whenever any number of determinations are to be made in a day, several may be drying while one is being burned, so there is but little time saved when proper apparatus is at hand. Accuracy should not be sacrificed to expense and there is a decided opinion amongst many prominent chemists that the wet combustion method is decidedly inaccurate. The tendency to imperfect combustion and the evolution of hydro-carbon gasses are held accountable for these errors.)

D.—Purifying the Evolved Carbon Dioxide.

First comes a Marchand tube, containing anhydrous copper sulphate to absorb hydrochloric acid which is followed by a calcium chloride tube.

MODIFICATIONS.

The first limb of the first tube contains anhydrous cupric sulphate, the second limb contains anhydrous cuprous chloride. This is followed by a tube containing dry calcium chloride.

Between the two tubes used in the above modification, put a small tube containing 10 c. c. saturated silver sulphate in sulphuric acid.

The first tube is filled with wet glass beads, this is followed by a calcium chloride tube,

The first tube is filled with a solution of silver sulphate in concentrated sulphuric acid. This is followed by an empty U tube which in turn is followed by a tube containing anhydrous copper sulphate and lastly comes the calcium chloride tube.

The first tube is a U tube containing anhydrous copper sulphate and cuprous chloride, which is followed by a sulphuric acid tube.

First comes an empty bottle, second is a bottle containing py-

rogallic acid solution, third is the silver sulphate solution, fourth is a tube containing sulphuric acid.

Nothing is used between the tube and the bulbs containing the barium hydroxide solution used for absorption.

(The difference in the solutions used for purifying is due to the variation in opinion as to the best method of removing any cholrine or hydrochloric acid which may come over from the combustion.)

E.—Absorption and Weighing of the Carbon Dioxide.

Absorb the carbon dioxide in a weighed Leibig or Mohr bulb containing caustic potash solution, followed by weighed calcium chloride tube. The difference in weight before and after absorption gives the weight of the carbon dioxide.

MODIFICATIONS.

Absorb the carbon dioxide in a weighed soda lime tube.

Absorb the carbon dioxide in a potsssium hydrate bulb followed by a calcium chloride tube and Leibig bulb containing sulphuric acid. The three of which are weighed before and after combustion.

Absorb the carbon dioxide in a weighed potassium hydrate bulb, followed by a weighed sulphuric acid bulb.

Absorb the carbon dioxide in a potassium hydrate bulb, followed by a tube containing dried potassium hydrate.

Absorb the carbon dioxide in a bulb containing barium hydroxide solution (25 grams in 1 litre of water). Filter rapidly, using suction, burn in a muffle, in a platinum crucible until white, and weigh as barium carbonate.

Absorb the carbon dioxide in a 10 bulb absorption tube containing 100 c. c. barium hydroxide. In extremely accurate cases it is necessary to dissolve the barium carbonate in hydrochloric acid and determine the sulphur, as some sulphur is always carried over.

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETARY.

STANDARD METHODS FOR ANALYSING IRON.

GRAPHITIC CARBON.

The term graphitic carbon in ordinary iron parlance, includes temper carbon and it is not possible to separate the two by chemical means. The distinction between them is one of structure. Chemical analysis at present confines itself to a separation of the carbon into two divisions, graphite and combined carbon. In cast iron the combined carbon is generally determined by subtracting the graphitic carbon from the total carbon. The line separating the combined from the graphitic carbon is somewhat indistinct. Different acids and different strengths of the same acid give different percentages of graphitic carbon. There is a fine opportunity here for a standardizing committee to fix an arbitrary rule as to the kind and strength of acid used in determining the graphitic carbon in iron. There are probably two reasons for this variation in the action of acids upon the graphitic carbon. The best known reason is the fact that the combined carbon includes a carbide which is only partially decomposed by hydrochloric acid, but is entirely decomposed by nitric acid. Irons containing this carbide carbon always give higher results when treated with hydrochloric acid than when nitric acid has been used as the solvent. The second reason is due to the fact that the different strengths of acids have different effects upon groups of carbon particles which probably form a transition between the combined and temper carbon.

White or chilled irons show the greatest difference when treated with hydrochloric and nitric acid. This is due to the fact that the carbide carbon in white iron greatly exceeds that in grey iron. A recent work on iron analysis makes the following statement: "The use of nitric acid is preferable with grey iron low in combined carbon, while hydrochloric acid is better for white iron

high in combined carbon." This is just opposite to what those familiar with the analysis of white and chilled iron have found. By far the larger number of methods examined now use nitric acid, but a considerable number still cling to hydrochloric acid for the solution of the sample.

A carbide of titanium undecomposed by hydrochloric acid is found in some pig iron. It is decomposed by nitric acid which gives another reason in favor of the latter as a solvent in graphite determinations.

The difference in the method of determining the amount of the separated carbon gives rise to another difference in procedure in determining graphite. Some burn the graphite in oxygen or by sulphuric acid and chromic acid, as mentioned under total carbon. Others weigh the carbon direct, while still others determine the amount of carbon by weighing the carbonaceous residue, burning off the carbon in a crucible and calling the difference graphite.

Several of the methods recommend the separation of the drillings with a magnet and determining the graphite in the portion which adheres to the magnet. This procedure is incorrect for any of the iron determinations, but it is especially so in the determination of graphite. A very much larger proportion of the graphite remains in the part unattracted by the magnet. Some mix the sample with alcohol before withdrawing the portion for analysis in order to more thoroughly mix the free graphite with the rest of the sample.

OUTLINE

FIRST STEP.

Solution of the sample.

Dissolve 1 gram of drillings in 20 c. c. nitric acid 1.20 sp. gr.

MODIFICATIONS.

Dissolve 1 gram in 100 c. c. nitric acid 1.20 sp. gr. and add 2 drops of hydrofluoric acid.

Dissolve 1 gram in 40 c. c. nitric acid 1.13 sp. gr.

Dissolve 1 gram in nitric acid 1.13 sp. gr. and add 3 or 4 c. c. of hydrofluoric acid.

Dissolve 1 gram in 60 c. c. nitric acid 1.135 sp. gr. boil keeping volume constant.

Dissolve 1 gram in a (2 to 3) solution of nitric acid and add 1 c. c. hydrofluoric acid.

Dissolve 2 grams in 40 c. c. nitric acid 1.20.

Dissolve 2 grams in 100 c. c. nitric acid 1.135 sp. gr. and add 3 c. c. hydrofluoric acid.

Dissolve 5 grams in 125 c. c. nitric acid 1.13 sp. gr. and add 10 c. c. hydrofluoric acid

Dissolve 1 gram in 100 c. c. dilute hydrochloric acid.

Dissolve 2 grams in 50 c. c. hydrochloric acid 1.12 sp. gr.

Dissolve 1 gram in 40 c. c. hydrochloric acid (1 to 1) for soft iron and in 20 c. c. nitric acid 1.20 sp. gr. for hard irons.

(Nitric acid 1.13 sp. gr. is in common use due to the fact that it retains a considerable amount of the silicon dioxide in solution and thus renders the filtering of the graphite easier. Some results frequently quoted of T. M. Drown A. I. M. E. Vol. III p. 41, bear directly on this step. The white and grey parts of the same sample were treated with hydrochloric and nitric acids with following results. Dissolve in hydrochloric acid 1.20, digested at moderate heat, evaporate to dryness, take up in hydrochloric acid, wash with water, sodic hydrate, alcohol and ether. Grey part gave percent of graphitic carbon 2.84. The white part gave percent of graphitic carbon 1.31, 1.47. When the samples were boiled briskly with hydrochloric acid for one half hour and washed as above, grey part gave 2.46 and 2.50 graphitic carbon; the white part gave .21 and .23 graphitic carbon Treat with an excess of nitric acid 1.27 and when action ceases add hydrochloric acid evaporate to dryness and proceed as above. Grey part gave 2.37 graphite; the white part gave .06 .03 graphitic carbon. The results show very plainly that some standard should be adopted as to the kind and strength of acids and time of boiling. The above is not an exceptional instance as those who have experience in analysis of hard iron can testify.)

SECOND STEP.

Filtering the Graphite.

A.—For combustion and weighing as carbon dioxide.

Filter on the same platinum boat or tube as described under **Total Carbon.**

MODIFICATIONS.

Filter on an asbestos plug for Shimer combustion apparatus.

Filter on a Gooch crucible with asbestos felt for Shimer combustion crucible.

B.—For direct weighing as graphite.

Filter through a weighed Gooch crucible.

MODIFICATIONS.

Filter through tared filters, placing the filters in separate funnels and pouring the filtrate and washings from the graphite residue through the second filter.

Filter through two counterpoised filters folded together.

C.—For burning off the graphite in the crucible and determining it by loss of weight.

Filter on a Gooch crucible, weigh the dried residue, burn off the carbon, and call the difference graphite.

MODIFICATIONS.

Filter on a Gooch crucible, using a paper disk in place of asbestos, weigh crucible with and without the disk.

Filter on an asbestos plug, transfer to a platinum crucible, dry and weigh, and determine the graphite by the difference in weight.

Transfer the tared filter mentioned in B to a platinum crucible and weigh. Burn off the carbon and determine the graphite by difference.

THIRD STEP.

Washing the graphite.

Wash the residue with hot dilute hydrochloric acid, then with hot caustic potash solution, then with dilute hydrochloric acid, and finally with water.

MODIFICATIONS.

Wash with hydrochloric acid, caustic potash, alcohol, ether, and water.

Wash with 10 per cent. nitric acid, and then with hot water.

Wash once with dilute nitric acid, thrice with hot water, twice

with 10 per cent. caustic potash solution, thrice with hot water, twice with hot dilute hydrochloric acid, thrice with hot water, and twice with ether.

Wash thrice with hot water, twice with hydrochloric acid(1- 1) once with water, twice with ammonia (1 - 3) twice with hydrochloric acid, five times with water.

Wash with water and hydrochloric acid alternately, then with ammonia and water alternately and then with water.

Wash with water, then with hot hydrochloric acid, then with hot water, then with 5 per cent. ammonia until washings are colorless, then with water till free from ammonia and finally with a mixture of alcohol and ether.

Wash with dilute hydrochloric acid, then with 10 per cent. caustic potash solution, then with hydrochloric acid, then with water and finally with ether.

Wash the precipitate from the double balanced filter into a beaker add 10 c. c. of aqua regia, boil, filter on same papers and wash with water. Wash again in the same beaker, add one-fourth of a stick of caustic potash, boil, filter on the same filter and wash with water.

(The various methods of washing have in view the removing of any solid or liquid hydrocarbons which are supposed to be insoluble in water alone. Potassium and sodium hydrate are used to dissolve any silica which might clog the filter or prevent a complete washing. When nitric acid is used as a solvent the hydrocarbons are supposed to be evolved or dissolved. Some of the methods for direct weighing wash the residue on a weighed Gooch crucible with sufficient acid and alkali to cause a variation in weight of the asbestos used and thus introduce an error.)

FOURTH STEP.

Determination of the Graphite.

A.—By estimating the evolved Carbon Dioxide.

The graphite on a boat, crucible or plug is transferred to a combustion apparatus and determined by the methods shown under Total Carbon.

B.—By direct weighing of the Graphite.

Weigh the graphite which has been filtered onto a weighed Gooch crucible, the silicon having been destroyed by hydrofluoric or caustic potash.

MODIFICATIONS.

Weigh the carbon on countorpoised filters. The difference in the weight between the filter containing the carbon and its counterpoise, equals the weight of graphite.

C.—By difference in weight between the carbonaceous matter and the residue left after buraing off the carbon in air.

Weigh the carbonaceous matter on a Gooch crucible which has been dried at 115° C., burn off the carbonaceous matter; 97 per cent. of the difference in weight equals the weight of graphite.

MODIFICATIONS.

Weigh the residue on tared filters. The difference in weight minus the weight of the residue left after combustion of paper containing the graphite is called graphite.

The weight of the residue on Gooch crucible with paper disk minus the weight of the crucible and the disk equals the weight of the carbonaceous matter. Burn off the carbonaceous matter and weigh the residue. Subtract the weight of the crucible without the disk and the remainder equals the weight of the residue not graphite. Subtract this from the weight of the carbonaceous matter and the difference in weight equals graphite.

Weigh the carbon on asbestos plug in platinum crucible, burn off the carbonaceous matter, difference in weight is called graphite.

The temperature to which the carbonaceous residue was heated varied from 96 to 120° C.

(The so called direct methods of weighing the graphite are not considered accurate by many authorities. It was a question whether it would be possible to adopt one of these methods as a standard owing to the fact that the accuracy varies with the different kind of iron analyzed.)

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE METALLURGICAL SECTION.

HERBERT E. FIELD, SECRETARY,

STANDARD METHODS FOR ANALYSING IRON.

COMBINED CARBON.

Authorities agree that an accurate determination of combined carbon in iron by the color method is practically impossible and state that the total carbon should be determined by combustion and the graphite by combustion, and the difference called combined carbon.

A considerable number of the methods examined stated that the color method was used for the determination of combined carbon in iron. The number who gave a detailed description of this method was insufficient to warrant an outline being made. The color method for combined carbon is valuable solely as an indicator of the percentage of carbon in steel and is accurate only when the standards used are of the same percentage and kind as the sample under analysis. It would be impossible for a laboratory to have a sufficient number of standards of cast iron to make this process accurate.

It is now well known that the color method depends upon the amount of combined carbon in two conditions. The so-called hardening carbon and the carbide carbon. The coloring power of these two differ and if we strike an average of what authorities say on this matter, it is probable that the carbide carbon exerts twice the coloring power of the hardening carbon. When one considers that the ratio between these forms of carbon depends upon the rate of cooling between certain temperatures it will be readily seen how difficult it would be to get anything like uniform percentages in a material such as cast iron.

It would seem therefore that great as the advantage might be that it would be practically impossible for a committee to adopt such a method for a standard in the analsis of cast iron.

PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART II.

PROCEEDINGS OF THE AMERICAN COMMITTEE ON STANDARD SPECIFICATIONS FOR CAST IRON AND FINISHED CASTINGS.

The meeting of organization of this committee was duly held in Philadelphia on April 25 as announced, 23 members being present, and 18 having sent letters of regret. Mr. Walter Wood, chairman, in his opening address reviewed at length the history of the movement toward better methods of judging cast iron and finished castings. He further described the action of the Congress at Buda-Pest when this question was brought before its notice, and finally the present status so far as America is concerned. Prof. Edgar Marburg, the Secretary of the American Society for testing Materials, who was present by invitation, also explained the position of the committee in relation to the various phases of the general problem, and a general discussion followed, participated in by Messrs. Wood, Marburg, Colby, Cook, Field, Kinkead, Outerbridge, Saunders, Souther, Touceda, Zehnder, and Moldenke.

A great number of points were brought out, among which the following may be mentioned. In the proposed pipe specifications it was urged to put in a clause limiting the sulphur contents, the erratic behavior of pipe with excessive amounts of this element, while passing tests of strength and soundness seeming to necessitate it. The representatives of pig iron were heartily in accord with the proposed standardization of the methods of buying and selling this material on chemical requirements. It was brought out that this method was now almost universal, that while the smaller foundries were still calling for grades, yet they also were gradually specifying chemical limits, and that it would be only a question of a short time when grade numbers would be obsolete. It was the sense of the

meeting that in regard to pig iron a suitable sub-committee should draw up specifications for the proper taking of samples, also if possible work on standardization of methods of analysis of these samples, to fix the limits of variation from the specified composition allowable, and to leave the fixing of chemical requirements for the different classes of castings to the respective sub-committees on those branches.

It was interesting to note the unanimity with which the representatives of pig iron and the buying interests alike desired the speedy consummation of this work of standardization; the varied requirements, limits of variation allowed, and occasionally very poor methods of sampling creating confusion and trouble for the parties of both parts, most of which could be thus avoided, even though at the present time this is nothing to what the old grading methods were chargeable with.

On the subject of pipe it was brought out that very little difficulty would be experienced, as this subject was practically shaped up by the various associations interested. It would then remain for our committee to adapt the results at hand to the requirements of international trade, and in this the assurance was given that the contestants for the world's markets are quite ready to co-operate.

The same was brought out for the car wheel interests. The Rail Road, or buying interests, have long gotten the matter of car wheel specifications into definite shape, and as Europe is beginning to look more favorably upon cast iron wheels, for economic reasons, a sub-committee on this line of foundry product would be expected to take the work already done, and adapt it for international purposes, always remembering that American practice should be represented in the specifiications to be prepared.

Malleables, cylinders, electrical and machinery castings, as well as castings made from furnace iron, also came in for some discussion. It was brought out that there were many varieties of work which required no specifications, such as stove and furnace castings, as they were bought for purposes other than strength and quality. When, of course, it came to radiators, or cast iron boiler parts, this was another matter, and these questions should be taken up in their turn further on.

The general subject of the testing of cast iron was next taken up. It was the sense of the meeting that this important matter

should be gone into with a view of specifying clearly how cast iron should be handled in the testing machines, what tests were the best ones to make, and as much light to be given on the subject as possible. The elaborate tests of the American Foundrymen's Association were referred to and the specifications adopted by that association were explained by its secretary. It was shown that the actual limits for strength for the various classes of casting were not given in these specifications, as it was felt that the consumers and others interested besides the foundrymen should have a say in this. The American Foundrymen's Association would therefore gladly welcome action on these matters by the International and American Societies for testing materials, having made the investigations in question only with a view of bringing out the best methods of properly judging cast iron on its merits, and specifying how this should be done in the light of experience probably not available to others not in the actual performance of this kind of work.

Finally it was resolved that all the work should be done by sub-committees appointed by the chair. The classes to be taken up being as follows:—Pig Iron, Pipe, Cylinders, Car Wheels, Malleable Cast Iron, General Castings, and Methods of testing Cast Iron.

As it is important to have some outline of the work ready for discussion at the coming convention of the American Society for testing Materials, to be held at the Delaware Water Gap, July 1, 2, and 3, it is expected that the chairmen of the various committees will draw up memoranda of the specifications, as they understand them to be necessary. Then they can as soon as possible, send these memoranda to the members, of their committee for criticism, revision and enlargement. After hearing from all the members, it is desired that the chairmen give their summary to the Secretary of the general committee for preparation for the convention, as well as for transmittal to the full membership of the committee for further discussion and criticism. When finally all this matter is in, it will be referred back to the respective chairmen for discussion and final shaping up by the respective committees, and then reported to the full committee for adoption and transmittal to American body for ratification and promulgation as the American Specifications for the testing of cast iron and finished castings. It then becomes a matter for International Conference.

The following are the committees appointed by the chairman, Mr. Walter Wood:

PIG IRON

Mr. Edgar S. Cook, Warwick Iron & Steel Co., Chairman.
Mr. Hugh W. Adams, Sloss-Sheffield Iron & Steel Co.
Mr. George H. Eldredge, B. Nicoll & Co.
Mr. Frederick A. Flather, International Harvester Co., Chicago, Ill.
Mr. Wm. Gerhauser, Superior Charcoal Iron Co.
Mr. W. W. Hearne, Matthew Addy & Co.
Mr. W. G. Scott, J. I. Case Threshing Machine Co.
Mr. C. H. Zehnder, Rogers, Brown & Co.

PIPE.

Mr. Walter Wood, R. D. Wood & Co., Chairman.
Mr. H. A. Croxton, The Massillon Iron & Steel Co.
Mr. J. K. Dimmick, Dimmick Pipe Co.
Mr. L. R. Lemoine, U. S. Cast Iron Pipe Co.
Mr. W. R. Webster, Consulting Engineer.

CYLINDERS.

Mr. H. V. Wille, Baldwin Locomotive Works, Chairman.
Mr. J. F. Kinkead, American Locomotive Works.
Mr. P. Kreuzpointner, Pennsylvania Rail Road.
Mr. E. R. Wood Jr., R. D. Wood & Co.

CAR WHEELS.

Dr. Chas. B. Dudley, Pennsylvania Rail Road, Chairman.
Mr. Geo. M. Davidson, C. & N. W. Railway.
Mr. R. Job, P. & R. Rail Road.
Mr. Wm. W. Lobdell, Lobdell Car Wheel Co.
Mr. A. A. Outerbridge Jr., Wm. Sellers & Co.
Mr. C. W. Sherman, Pennsylvania Malleable Co.
Mr. A. W. Slocum, Keystone Car Wheel Co.
Mr. C. H. Vannier, Griffin Wheel Co.

MALLEABLE CAST IRON.

Mr. Stanley G. Flagg Jr., Stanley G. Flagg & Co., Chairman.
Mr. H. E. Diller, Western Electric Co.
Dr. Richard Moldenke, American Foundrymen's Association.
Mr. S. H. Stupakoff, German-American Society of Technologists.

GENERAL CASTINGS.

Mr. Thos. D. West, Thos. D. West Foundry Co., Chairman.
Mr. Jas. A. Beckett, W. A. Wood Mower & Reaper Co.
Mr. L. M. Fenner, New York Air Brake Co.
Mr. P. S. Hildreth, Consulting Engineer.
Mr. A. E. Loudon, Associated Foundry Foreman.
Mr. R S. MacPherran, Allis-Chalmers Co.
Mr. David Reid, American Machine Co.
Mr. W. M. Saunders, Consulting Metallurgist.
Mr. B. Viola, German-American Society of Technologists.

TESTING CAST IRON.

Mr. Henry Souther, Consulting Metallurgist, Chairman.
Mr. Jos. W. Bramwell, Falkenau-Sinclair Machine Co.
Mr. W. DuComb, Riehle Bros. Testing Machine Co.
Mr. H. E. Field, Farrell Foundry & Machine Co.
Prof. Wm. K. Hatt, Purdue University.
Mr. J. C. Henshaw, N. S. Bartlett & Co.
Prof. G. Lanza, Mass. Inst. of Technology.
Mr. Edward Schroeder, with Dr. Chas. F. McKenna.
Prof. H. W. Spangler, University of Pennsylvania.
Mr. Enrique Touceda, Consulting Metallurgist.

It was further stated that the General Committee would be glad to add further names to their number and all members were resquested to feel free to suggest any names that they felt would add strength to the committee. The Chairman was given the authority to assign any new members to any committee that he felt desirable.

PROCEEDINGS OF THE NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

The Iron Age, April 16. The monthly meeting of the New England Foundrymen's Association was held at Hotel Essex, Boston, Wednesday, April 8. There was a large attendance, more than the usual number of members being attracted by the promised papers and by the fact that they had matters of importance to discuss. Henry A. Carpenter, of Providence, the president of the association, was in the chair. A brief business meeting was first on

the programme, at which two new members were elected—the Starkweather & Williams Company of Providence. R. I., and Henry Souther, of Hartford, Conn. Two papers were read, one at the close of the business meeting, before dinner, by O. C. Barrows, accountant for the A. Carpenter & Sons Foundry Company, of Providence, on "Foundry Accounting and Methods of Estimating Costs of Castings," and the other, after dinner, by F. T. Towne of the Yale & Towne Mfg. Company, of Stamford, Conn., president of the National Founders' Association, on "The Labor Situation in Our Foundries." Naturally both papers were heard with deepest interest. Mr. Barrows illustrated with a series of cards used in his cost system; copies of which were given each of the members present. It was voted by the association to print this paper in full for circulation, including the illustrating cards.

PROCEEDINGS OF THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The Iron Age, April 9. The regular one hundred and twenty-seventh meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club in that city, Wednesday evening, April 1.

President Devlin, after calling the meeting to order, announced in a few words the death of Thomas I. Rankin, the late president of the association, who died suddenly on March 22, from complications resulting from a surgical operation. Mr. Rankin was a man of high integrity, sterling worth and exemplary character, and his loss will be greatly felt by the association. Eulogistic remarks were also made by Josiah Thompson, W. H. Ridgway, Horace Evans and others after which it was moved that a committee be appointed to prepare suitable resolutions of regret to be presented to the late Mr. Rankin's family and to his former employers, the Abram Cox Stove Company, and to be inscribed on the minutes of the association. The motion being unanimously passed, the president appointed the following committee: Josiah Thompson, O. J. Ward, Thos. J. Kelly, Howard Evans. They will report at the next meeting.

The report of the treasurer, showing a balance of $2101 on hand, with all bills paid, was read, and there being no other business be-

fore the association, the paper for the evening was announced, the subject being "The Schwartz Melting and Refining Furnace" by Edward H. Schwartz, Chicago, Ill. In Mr. Schwartz's absence the paper was read by Geo. C. Davis. It was illustrated by lantern slides.

There being no discussion on the subject, the programme was proceeded with, and portions of a paper entitled "Melting Steel with Cast Iron," by R. P. Cumningham, Holyoke, Mass., were read after which the meeting adjourned.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Journal of the
American Foundrymen's Association.

REVIEWS.

Vol. XI. Part III.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS
R 1903 L

Journal of the American Foundrymen's Association.

VOL. XI. NOVEMBER, 1902. PART III.

ACID PROOF AND REFRACTORY VARIETIES OF CAST IRON.

Eisenzeitung, Nos. 1 and 2. The German Metallurgical Engineer, Carl Rott, writes on a subject which has troubled many of our manufacturers of this country also. In the evolution of foundry mixtures intended to produce iron which would be acid proof, as well as castings which could resist the application of heat to the greatest degree possible, the controlling idea has been the elimination of the ingredients which tend to reduce the resisting power of the materials to heat or chemical action, as the case might be. Thus for acid proof castings it is essential to have irons as low in sulphur and phosphorus as possible; then also the carbon should be in the combined form to as great an extent as may be safely allowed. Mineral and vegetable acids affect irons readily which have high sulphur and graphite contents. Silicon and manganese do not seem to be affected as much. Here is the composition of good irons of this kind: Silicon 0.8 to 2.0; phosphorus 0.4-0.6; sulphur .02-.03; manganese 1.0-2.0, and total carbon 3.0.3.5 per cent. Makers of pumps for mining purposes or where there is acidulated water coming from factories would do well to make a note of this. It is important to have clean coke, furnace iron would be better, as it is freer from oxidation. Where the castings are not to be machined the fracture may be mottled to nearly white; where machining is done the grain should be as close and fine as may be allowable. To help a little in the latter case an annealing of 24 hours can be used with advantage. Now as to the refractory castings. This, Mr. Rott thinks, is not so difficult a problem. A low

sulphur contents is essential; phosphorus may be normal and manganese low. It is well to have low silicon and carbon. Scrap steel is therefore a good admixture. Here is a typical annalysis: Silicon 1.8; phosphorus 0.7; sulphur .03; manganese 0.6, and total carbon 2.9 per cent. Melt hot and vent the molds well. Mr. Rott concludes his article by warning German foundrymen from adopting so-called American processes, as they are sure to find upon trial under the different conditions existing in the Fatherland. The few processes he describes turn out to be the ones we have branded as frauds over here ourselves.

FOUNDRY IRON AND MELTING METHODS.

Stahl und Eisen, Jan. 1st. In an address under above title, and delivered before the Iron and Steel Association of Upper Silesia, General Manager Grau gives a very interesting picture of the foundry industry of Germany. After discussing the methods used for the production of foundry irons at the furnace he takes up the foundry. He claims that all German foundry irons are good, which is news to us here who have been led to believe quite the contrary. He explains this, however, by stating that the high phosphorus ores are all bought up for steel making, which leaves only the purer ones for the foundry. Fortunate German foundrymen! We Americans would be apt to discount any such optimistic views when coming from a blast furnace owner. In discussing cupolas it is held that nearly all the intended improvements are in the direction of saving coke. This circumstance Mr. Grau says should make us careful to observe whether the saving of the coke is not counterbalanced by an equivalent oxidation of the metal in the removal of parts of its silicon and manganese. The result he thinks would be excessively hard iron. The proper way to economize coke is in preheating the blast by the hot gases passing out of the cupola. We are warned, however, to look out for the oxidizing effect of a warm blast. Mr. Grau also advises that the tuyeres be kept above the bottom as much as possible to avoid a direct blast of air on the melted bath. An alternative would be the addition of the forehearth. This forehearth, however, the lecturer condemned on account of the tendency to chill the iron and, as he claims, the promotion of an ununiform mixture. The advice given would then seem to lean toward the retention of large

bodies of melted metal in the cupola—in other words the Bessemer Works Cupola process, a process which is found undesirable for foundry work here, preferring as we do to tap often and fill bull ladles to get good mixtures, plenty of coke being used to get good hot iron. In one respect, however, Mr. Grau is correct, and that is the mistake in leaving the cupola tender or foundry foreman do the mixing. Once these gentlemen hit upon a mixture making nice smooth castings it is used indiscriminately for all purposes, whether the castings are heavy or small. The constitution of the irons used is not known nor the mistakes in grading which may have been made noted. Fortunately in our country this is passing away, and many are the foremen who can sit down and figure out good mixtures for given purposes and know just what they are doing. Another point of interest is brought out by Mr. Grau when he states that all parts of the mixture do not melt equally fast in the cupola and hence the irons poorer in phosphorus should be broken up into smaller pieces. Finally stirring up the ladle before pouring large castings is recommended in order to get a uniformly mixed iron. Mr. Grau now turns to the political side of the foundry question and explains why American agricultural machinery is exported to Germany in such enormous quantities. He says that this machinery is unquestionably superior in quality to theirs and this is only due to the enormous production of the individual exporting foundries of America. The sharp inspection before shipping, the organization of the founders for this work and the selection of men who are educated for their work make this excellence of product possible, and the commentary is that Germany should do likewise. Mr. Grau advocates a sort of foundry trust with headquarters to receive all orders, which are to be distributed to their works best able to produce the desired castings. Standardization of agricultural castings as well as strengtn of the iron in them should be sought for. American foundry practice is held up as an example in this respect which should be followed.

IMPROVEMENTS IN CUPOLAS.

The Foundry, February. Dr. Edward Kirk reviews the history of cupola construction, beginning with the early stationary bottom draw front apparatus, built upon a stone foundation three or four feet high or else upon a hollow foundation with a cast iron plate to

top it. The casings were made of cast iron, the lining was arched over the front and the opening closed with an iron apron fastened to the casings and lined temporarily with loam to keep it from burning out. A small opening in the apron served as a tap hole. This peculiar style of old fashioned cupola is described at length by Dr. Kirk and may still be seen in a Baltimore foundry, where they have held their own sinee 1813. The difficulty with this style of cupola is to get out the refuse, slag, etc., after the heat was finished. The moment the cold air entered everything chilled and had to be sledged off. The drop bottom was a great improvement. It was supposed to come from New England, and is said to be an American invention. It was introduced about fifty years ago and took a long time to become generally adopted. In olden days the stacks of the cupolas were made larger than the crucible, the casings consisted of cast iron stacks held in place by wrought iron bands, and eight feet was considered a high cupola. Blast was admitted through two tuyeres opposite each other and the melting was necessarily slow. The various improvements in the location and shape of tuyeres are now enumerated, and Mr. Mckenzie's radical departure in this line explained. This was the ten hour cupola. His idea was to abandon the driving of blast to the centre in the shape of two small jets of air, and substitute therefor a wind box with a lot of tuyere openings which gave quantity of air rather than intensity. Next came the Lawrence, Pevie and Dougherty cupolas, all of them having special merits over the old and each other. Colliau's plain round cupola followed all the above in 1874 and from all possible shapes cupola design got back to the style of 40 years ago. After numerous changes the modern cupola is back to the old form, but much improved in its details and general adaptations to modern requirements. Dr. Kirk advises foundrymen to buy the cupolas now made by regular manufacturers rather than to construct them at the place.

THE FOUNDRIES OF THE U. S. AND CANADA.

The Foundry, February. The foundry trade is greatly indebted to "The Foundry" for its work in compiling accurate lists of all the foundries in this country. On January 1, 1902, there were 4,615 of them. The capacity is fully thirty per cent. above what it was two years ago. Such has been the remarkable activity of

this industry of late. Pennsylvania, New York, Ohio, Illinois and Michigan contain 2,269 foundries, or nearly one-half of the trade. New York has most of the brass foundries, Pennsylvania being first in those of iron. There are now 107 "malleable" foundries, Illinois leading the rest with 18, Pennsylvania coming next with 16. The capacity of the old plants has been largely increased. In steel casting plants Pennsylvania leads with 29 establishments, or 40% of the total number. Chicago still maintains the leadership of the world in having the greatest number of foundries within its confines, though Philadelphia has the greatest variety of them, Pittsburg coming third. The article concludes with a list of foundry consolidations recently consummated.

FOUNDRY DEVELOPMENT IN THE PAST TWO YEARS.

The Iron Trade Review, January 16. In an editorial on the above subject attention is called to the remarkable growth of the foundry industry in this country. Existing plants have been enlarged and new ones built by the score. The cause of all this is the enormous home demands for castings going into machinery of all kinds. Not only the regular jobbing foundries have been running very full, but light gray casting, malleables and steel have been in requisition in unheard of quantities. "Penton's List," the acknowledged authority on the statistical side of the subject, summarizes the iron foundries existing at the present day in the United States at 4,615, a gain of 470 in two years. Add to this 875 brass foundries, and we have a total of 5,490 foundries of all kinds. There are now 107 malleable foundries, 72 steel foundries, and 269 stove foundries. Canada has 501 iron and 26 brass foundries, which shows a looking up of the trade in that country. The principal hold of the trade is in the States touching the great lakes. The outlook for continued prosperity is good and a year of extensive operations is predicted.

CAR WHEELS, THE ALLEGED DECADENCE OF.

The Iron Trade Rewiew, January 2. Mr. William Fawcett discusses the reported dissatisfaction with the cast iron car wheel when used in very heavy freight service. It seems that the officials of some of the large railroads think that car wheel makers could do much better than they are, and thus produce wheels with

greater life under the heavy cars put out at present. It is further claimed that our wheels are gradually degenerating year after year, and the once magnificent specimen of iron is replaced by one comparing very unfavorably with former days. Car wheel makers claim that they are getting too little money to turn out the best grade material. They sell wheels at $22.00 a ton and must take back an equal weight of scrap at $17.00. It is an injustic to expect the makers of good wheels to take back and use scrap coming from everybody. Again Mr. Fawcett holds that to get the best results only a limited proportion of scrap should be used, and melted with the highest grades of irons low in phosphorus and sulphur. In fact the phosphorus contents should not be allowed to run over 0.325 in any wheel, and similarly sulphur not over 0.07. An originally good wheel when remelted increases in sulphur, and as this remelting proceeds ad infinitum, with intervals of 5 to 7 years, the iron must naturally become more and more charged with sulphur, and hence be poorer in good qualities. A plea is finally made for relief from onerous specifications.

THE CONDITION OF SILICON IN CAST IRON.

Stahl und Eisen, February 15. Mons. P. Lebeau discusses this question in the "Comptes rendus." He claims that the theories advanced by previous investigators are faulty, and gives a number of experiments to prove that all the silicon present in cast iron and low silicon ferrosilicon is there as SiFe 2. First of all he got some silicon powder and treated it with nitric acid and also with the double chlorides of copper and potassium. It was not affected though remaining for 12 hours in contact with each of these reagents. On the other hand cast iron treated thus gave a residue in which no pure silicon could be found. There is no question therefore but that all the silicon present is in combination, and this was afterwards proved to be a silicon iron compound. To test the permanency of this compound SiFe2 it was melted with silver, in which it dissolved After cooling the alloy it was dissolved in nitric acid and the residue again gave the silicon iron compound. The solution contained no trace of iron or silicon. The alloy of silver and silicon-iron was placed in the electric furnace and the silver volatilized at the melting point of cast iron. Crystals of silicon-iron were left behind again. This is all additional proof that the same compound is the

one existing in cast iron. Mr. Lebeau concludes that this compound is dissolved in the excess of iron present in cast iron and the whole material upon setting becomes a homogeneous mass so far as the silison is concerned.

METALLOGRAPHY IN CAR WHEEL MANUFACTURE.

The Iron Age, February 20. Mr. A. W. Whitney discusses the recent articles which have appeared on the car wheel, its decadence, merits, etc. He objects to Mr. Fawcett's sulphur and phosphorus limits, claiming that good wheels can be made with sulphur as high as 0.10 and phosphorus 0.40, while neither low phosphorus nor the steel percentage in the wheel is a safe criterion of the quality of the product. Mr. Whitney also holds that Mr. Slocum's dictum that no satisfactory wheel can be produced without using at least some old wheels is beside the mark, and gives instances where he made car wheels of only pig iron which were perfectly satisfactory. A more careful study of the structure is required, and this is connection with the chemical constitution should give wheel makers ideas for the betterment of the material. Mr. Whitney holds therefore that microscopical examinations should be made of the metal in order to study its peculiarities. Six illustrations are given which show hard and other cast irons when photographed under the microscope. It is safe to add that much more must be done in the metallography of cast iron before it can be made available to the founder as an additional method of study in his taade.

THE INFLUENCE OF PROPER CUPOLA PRACTICE ON THE COMPOSITION OF CASTINGS.

The Foundry, August. Mr. F. W. Stickle discusses this question from a practical standpoint. The contact of the iron with the fuel, the amount of air used and other conditions are so influential that the same mixture produces altogether different kinds of castings on different occasions. This Mr. Stickle discovered before he knew anything about the chemistry of the foundry. He thinks that it is necessary to hold the cupola up to the proper lines determined by experiment, and to run it carefully in order to get castings of proper composition and physical qualities from proper mixtures.

PHOSPHOR BRONZE FOR HYDRAULIC CASTINGS.

The Brass Founder and Finisher, July 15. Mr. E. S. Sperry writes on the above subject in the "Aluminum World," to remove

some of the misconceptions in regard to the making of castings to resist high pressure, so far as metals other than iron are concerned. It is a patent fact that no matter what mixtures are used the castings must be sound, for sweating through the pores of the metal must necessarily cause its rejection. The imperfections of sand castings consist of the existence of oxide and foreign matter, blow holes, shrinkage cracks and crystallization. Oxidation is perhaps most prominently seen in the aluminum alloys and hence this metal is avoided for the work under discussion. This trouble of dross being to some extent a mechanical one, suitable skim gates, gating from the bottom, and the addition of special risers will be found a great help. The best solution of the oxidation problem is the use of alloys which do not form injurious oxides when melted, and these are the phosphor-bronzes. The crystallization in a casting which produces spongy places when the metal has cooled are found most frequently in the alloys of copper with zinc, and copper, zinc and tin. Copper and tin alone makes an alloy fairly free from this trouble. Zinc is therefore to be avoided for pressure castings. Casting at a low temperature or in chills is to be recommended. Blow holes come from overheating the metal or letting it stand exposed to fire too long. The solution for trouble is obvious. Shrinkage cracks may be caused by too hard sand ramming, unyielding cores and imperpectly designed patterns. It is taught us by experience that phosphor-bronze makes the best all around metal for hydraulic work. The addition of phosphorus effects a removal of the film of oxide forming on the surface of the metal as well as that dissolved in it. The amount of phosphorus used where the alloy contains 10 to 12 per cent. of tin and risers are remelted should be about 0.25 per cent. With new metal 0.10 per cent. is sufficient for all purposes. When the tin goes above 12 per cent. reduce the percentage of phosphorus. Here is a new formula: For a tough alloy, copper 90 per cent.; tin 19.75 per cent.; phosphorus 0.15 per cent., or copper 9lb.; tin ½lb.; 5 per cent. phosphor-tin ½lb. For a hard alloy, copper 87.50 per cent.; tin 12.25 per cent.; phosphorus 0.25 per cent., or copper 8¾lb.; tin ¾ lb.; 5 per cent. phosphor-tin ½ lb. Keep lead and zinc out of the mixture. If the casting of phosphor-bronze leaks under pressure, dry it out and soak it while hot in melted parafine. This may close it up.

POURING TEMPERATURE.

The Foundry, September. Mr. F. W. Stickle holds that the chemical composition of the mixture, the design of the casting, the management of the cupola, and the method of molding have much to do with the proper pouring temperature to be selected. The gating is also important. In general a casting which is to be finished is to be poured hot, as if poured too cold the difficulties coming from segregation may make the castings worthless. Mr. Stickle claims the iron coming from the cupola dull is in a different condition from hot iron which has cooled down in the ladle. Silicon and manganese, in general, should not be necessarily high, as strength is thus sacrificed.

THE DAY'S WORK.

The Iron Trade Review, June 12. Mr. P. D. Wanner, in a paper read before the Philadelphia Foundrymen's Association, discusses this vexatious question. It seems that by general consent 10 hours is considered a fair working day for store, shop, farm and mine, but of late labor agitations are trying to make an 8 hour day and are using political weapons to enforce this. A bill has passed the House on May 20, 1902, requiring a clause in each contract to which the United States, the territories and the District of Columbia are a party, stipulating that the 8 hour day shall rule, and a forfeit of five dollars be imposed for each day per man working over this number of hours. It this bill passes the Senate, the President will sign it and then it remains to test its constitutionality. In the meantime it will work much worry on the Government authorities, and be an injustice to all men not fortunate enough to get Government jobs. Mr. Wanner holds that a nine hour day is a much better one than either the 10 or 8, and gives better scope for effective work. The average man is by nature lazy, and works only as much as he has to to support life. To accumulate wealth as a nation; it must work, and every hour more of work daily, so much more wealth is produced. The highest wages are paid only where there is the most surplus product of labor. Relieve this and you reduce the wages. The wealth producers are those who by their labor and intelligence with the use of so-called capital, call forth the various industrial enterprises. The lower strata bear the

upper, and have the privilege of going upward, but not all succeed. Mr. Wanner closes with a strong plea for the 9 hour day. Mr. Sterling, in discussing Mr. Wanner's paper, gave an instance in his own works where it had paid to gire a 9 hour day voluntarily in order to secure the proper kind of help.

THE FIRST FOUNDRY IN AMERICA.

From the daily press we hear that the Leonard family are to erect a memorial monument at Taunton, Msss , in honor of the first foundry built in America. It is to cost about $200,000. Mr. Lewis A. Leonard writes the "*American Machinist*," "It is claimed for the Leonards that they were the first successful iron master of America. For eight or ten years previous to the building of the bloomery in Taunton a casting was made here and there. They had to do with many of these efforts. But that the iron business was put on a successful commercial basis at Taunton, Mass., by the two men whose memory it is proposed to honor is freely admitted by all who have carefully examined the earlier records of this industry."

In the issue of October 2nd we find further :

"At the Old Home Week exercises held this Summer at Carver, Mass., an interesting paper relating to the early history of the town was read, in which it was shown that, as far as is now known, the first actual casting of iron in America was done there, the article produced being a teakettle. The first furnace was in operation in 1735, and a second one was built in 1760, the latter date being that of the historic teakettle. The successor of this second furnace is still in operation, under the firm name of the Ellis Foundry Company. Carver seems to have been the first home of a now prominent foundry. The Federal Furnace was established in 1793 and survived until 1841, when it was burned, the proprietors being Bowers & Pratt, who then moved to Boston and established the Highland Foundry at Roxbury. Another Pratt established a furnace at Wenhem, Mass., the same year, and his son later opened the Watertown foundry, now so well known as that of Walker & Pratt. The paper above referred to had to do with genealogies rather than with foundry history, so that its account is not as full and clear as from our view point could be wished.

THE FOUNDRY.

The Tradesman, August 1. This is the title of an interesting address delivered before the Patternmakers' Union, of Cincinnati, by Mr. Jhmes W. Gibney. The discourse was more on general lines, well familiar to our foundrymen, but valuable just the same. Toward the close of the address, however, there is some excellent advice given the patternmaker, his apprentice being counseled to spend as much time in the foundry as possible in order to get the proper conception of the molder's necessities. A perfect pattern for the foundry cannot be made by learning how to do it at a distance. Speaking of coreprints in the drag of a mold, Mr. Gibney asks why they are made with straight sides when a good taper will answer so much better. Where cores do not cut through, the molder and coremaker are kept guessing what to do. It would therefore be good practice for the patternmaker to outline these cores on the pattern. Mr. Gibney says further "fillets and round corners are always perferable to square corners for obvious reasons. Light lumber and poor bracing should be eschewed in large patterns. Such a pattern won't last. Rapping plates should be secured and placed so that they will withstand the sledge and not tear out and loosen after the rapping bar has been used a few times. A good varnish should always be used, and all dove-tails and dowel-pins made to work easy.

"The same abvice applies to core boxes. They should be substantially built so as to preserve their shape. For large cores, 'knock down' core boxes are perferable to solid ones. It is absurb to see a coremaker under the necessity of rapping a box to free it from the core and then have to patch up and finish the square edges of the core, when all trouble could be avoided by the use of a box that is constructed so that it can be taken apart. Blocking does not materially increase the size of a core, and if properly made and no sagging or distortion takes place, the dried core should be exactly as it leaves the core box ; there is no expansion of a core in drying.

The question of shrinkage is one which must be carefully considered by all patternmakers. One-eighth inch to the foot was at one time the standard, but more recent investigations demonstrates that irons vary in shrinkage, so that it cannot always be controlled to a fraction of an inch. General practice now, however, favors

an allowance of about one-tenth inch to the foot. No better advice can be given either to patternmaker or molder than to study closely the characteristics of the metal in which they are both so deeply interested. Its peculiarities must be known to be provided against or taken advantage of, and without an intimate knowledge of them neither patternmaker nor molder can do their best work.

CASTING PIPE.

Eisenzeitung, No. 33 and 34. It seems that in Germany government and town officials are beginning to specify their gas and water mains cast flanged portion downward instead of this end up as is usually done. A number of illustrations are given showing the defects of pipe flanges when forming the upper end of the mold. Not only do we find sponginess, blow holes and shrinkage spots, but there are differences in the diameter of the flanged portion as well as casting strains which make a sound lead joint a problematical one. It is claimed that by casting the pipe flange downward all these difficulties are obviated and that material advantages result from a proper equipment for this method of casting. It is claimed that the cores and molds themselves can be dried cheaper and better when thus arranged, that a better looking casting is the result, and that the dimensions are kept better. The castings are furthermore sound and better able to resist hydraulic pressure, and the loss is much lighter. Again the sinking head is only one-third the weight, with the advantage this means. It is further claimed that cheaper irons, that is, irons lower in silicon, can be used to advantage with excellent results.

WHY CHILL ROLLS BREAK.

Tin & Terne, March 20th. *Fer Blanc* gives some information on the subject. As a rule when the roll breaks it is a commercial question rather than one of finding out why it happened. The mill superintendent wants a rebate from the foundry, and the foundryman decides for himself whether it is good policy to submit to the terms demanded. A good chill roll should possess three characteristics. A high tensile strength with no weak places. It should have casting strains, and the coefficient of expansion of every part of the roll should be as nearly identical as possible. Were these ideal conditions attainable to the fullest extent, only

extremely bad mill practice would destroy the roll. In general the selection of good irons gives a high tensile strength. Good proportion of the sinking head, with the possibility of keeping this fluid for the maximum time will do much to eliminate the weak spots. It is an impossibility to cast a roll without internal strains, the chilled portion sets at once and the rest cools more gradually. When the whole casting has set the temperature becomes more evenly distributed, and the roll gradually cools. It is necessary to see that the roll does not become elliptical through unequal cooling. Regarding the question of the coefficient of expansion of the roll, it will be known that the chilled portion of the roll expands differently from the gray interior. Now it can readily happen that the roll may be so overheated that rupture in the outer particles takes place from this cause. The consequence is that a chance is given for surface cracks to run inward and eventually break the roll. *Fer Blanc* concludes with some interesting suggestions relative to the method by which the internal strains of a roll may be studied. Considering the amount of money involved annually in the replacement of broken rolls and the amount of argument and trouble created, this would amply be justified.

THE SAND BLAST.

The Iron Trade Review, June 12. Mr. A. G. Warren, of Philadelpaia, Pa., discussed his sand blast system in a paper read before the Philadelphia Foundrymen's Association. The following points are of interests in this connection. The foundry has used the sand blast process for ten years already, though it is about 30 years old. The machine should be strongly built to resist rough usage of unskilled labor. Plenty of hand holes should allow obstructions to be removed easily. All parts liable to wear should be easily replaceable. A specially made hose of Para rubber lasts about 6 months or one year. Hard iron tips and nozzles give the best satisfaction. The sand should be hard and tough and not too fine, and be thoroughly dry and cool before using. Overheating destroys the grain by unnecessary breaking up. Use a good air compressor. For a brass casting use 10 lbs. pressure. For gray iron 15 to 20 lbs. For steel castings 25 lbs. per square inch should be the rule. The size of openings of the nozzles varies from ⅜″ to ¾″, depending upon the work in hand. The great amount of dust

produced makes it advisable to provide a seperate room for the installation and an exhaust for the removing the dust. Preparations should be made to use the sand over again. Sand blast tumbling barrels are also very economical. As a rule where well installed an equipment pays for itself in three years. It is also advantageous for galvanizing purposes.

A NEW MOLDING PROCESS FOR REPRODUCING PATTERNS.

American Machinist, August 21, describes a new molding process by which a large number of patterns can be reproduced from one original master pattern. First a permanent or master pattern is made of wood, a mold is made with it in the usual way; this is filled with melted rosin. The rosin is then used as the pattern for the duplicates of the original, the sand being packed around it, and the rosin then melted out. Metal poured in as usual will give an excellent counterpart of the original pattern. While the idea is novel, its use seems to rest only in getting a little better finished series of castings for duplicate patterns. We hope to hear more of the process.

FOUNDRY FLASKS.

The Age of Steel, page 80. Mr. P. R. Ramp gives his ideas on foundry flasks and holds that this item is one of the important ones in the expense account of every foundry, Often a large and expensive flask is made where the job should have been bedded in the floor. A good flask is always the safest and cheapest one in the long run. If an all iron one is too expensive, one with iron ends and wooden sides will do. Fig. 1 represents such a flask in use for the bed of a small ice machine. It is 6 ft. long, 3 ft. wide, and has an 8 inch cope and 20 inch nowel. The iron ends (A) are 1½ inches thick and the trunnions (B) are about 3¼" in diameter. The pins and plates (C) are much larger than is usually the custom, to prevent them from becoming loose and allowing shifting. Only two pins and plates are used, both of these placed on the same side. Fig. 2 gives a sectional view of the trunnion and iron end on a flask of this kind. It will be noticed that at the joint between the iron and the wooden timber which forms the side of the flange, the one indicated by the letter (a) in figure 2. An iron end of this kind is not as safe as when the additional flange B is used, as the

lifting is done by the trunnions and all the strain is on the bolts that hold the timber and iron ends together. When the mold is lifted these bolts have a tendency to give, and cause the end of the flask

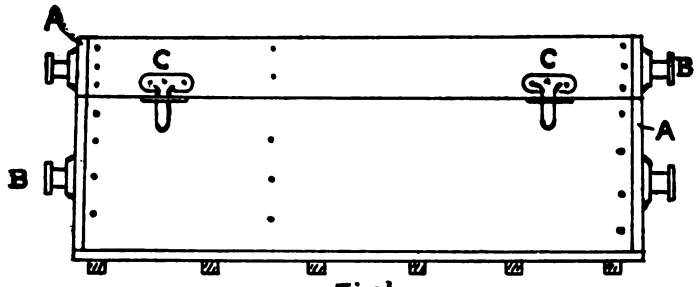


Fig.1.

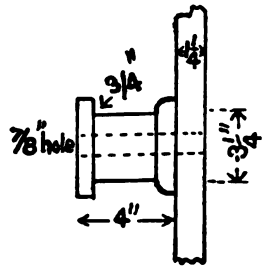
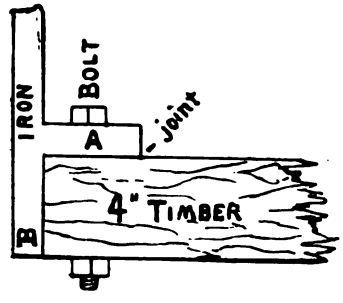


Fig.2.



to draw away from the sand, which often results in a drop out. Where, in case of the additional flange shown at letter B, the timber is butted up against the flange—which prevents the flask end from

twisting—this releases, to a certain extent, the strain on the bolts. Where it is possible, it is practical to use trunnions on a flask, as there is less strain on the mold in rolling over the drag, lifting off

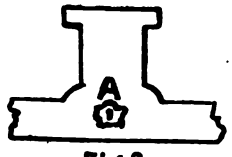


Fig 3.

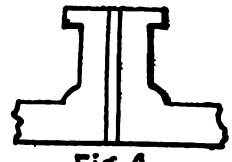


Fig 4.

the cope, etc., besides, much less room is required to use a flask with trunnions, as it can be hoisted up, turned over and lowered down in the same bed. In casting a trunnion on the iron ends of a flask it is advisable to core a hole through the centre of the same. This strengthens the trunnions, as otherwise there generally is a shrink hole found in the center of the casting, at the point near the plate, which makes it weak and dangerous. What should be done is to core out the heavy body of metal that is the cause of the shrink hole, shown at (A) in Fig. 3. This would cause it to resemble Fig. 4.

FOUNDRY COST KEEPING.

The Iron Trade Review, August 7. "S. F." explains a method by which foundrymen can keep an accurate account of the cost of castings of all kinds. First the cost of pig iron and scrap is known, and the weight of the castings gives the cost of such raw material with the required percentage of shrinkage by going through the cupola. Next, a card system shows how the labor cost is ascertained by taking accurate account of the time spent per day on each piece and figured up for total cost when charging the castings for delivery from foundry. Then comes the proportionate cost of supplies and material other than iron, scrap, coal and coke. This includes light, taxes, sand, facings, etc. Fourth comes the cost of non-producers, from Superintendent down to the ordinary help not directly chargeable to molding. Some details are now given regarding the system. On the score of the iron 1 cent per lb. is usually allowed for the cost of melted iron and the fuel used, in or-

dinary times. One-quarter of the actual weight of the castings will represent the cost of the non-producers. Add to this the actual number of hours molding, at the rate paid; add cost of cores, finally 25 per cent. further cost of supplies, and the total cost is the amount spent for each casting. Thus an example is given, as follows :

Weight of casting, 9,000 lbs. @ 1 ct.	$90.00
25 per cent. for non-producers,	22.50
Molders @ 30 ct. per hour., 4.5 days,	13.50
Helpers @ 15 ct., 3 days,	4.50
Coremakers @ 25 ct., 3 days,	7.50
Cleaners @ 20 ct., 2 days,	4.00
Total for labor and iron,	$142.00
25 per cent. for supplies,	35.50
Total cost.	$177.50

or $1.97 per lb. cost. A number of fac similes of cost cards are given, to which those interested are referred. These cards are of three different colors. A white card is used for the original order, with a duplicate on a white card prepared by carbon, this duplicate remaining in the foundry, for further reference, the original card travelling to the cost clerk after the order is completed. A colored card is used for cases of partial delivery, the original card being retained until the order is completed. Another colored card is used for rejected castings. The following forms are used : No. 1, cost card, 6 " x 4 ", gives original order number, when pattern was received, with shipping directions. Then comes name of customer, date of cast, when billed, the number of castings, description, weight, total cost, and cost per lb. No. 2 is for rejected castings, 13½ " x 6 ". The name of the casting, when rejected, for what cause, the name of foreman, molder and apprentice, the weight, molder's time and helper's time, and total cost being given. No. 3 is the cupola sheet, 11 " x 8½ ". First comes the name of the mixture, the weight of coal, coke, foundry scrap, yard scrap, other scrap, six columns for pig iron, and total for metal charge. At the bottom of the columns a line is left for totals, which gives total amount of fuel and various kinds of scrap and pig iron used, for stock yard records. Below this is noted the time of lighting, blast on, first tap, bottom dropped, length of heat, condition of iron, and fuel ratio. The sheet is signed by the foreman daily before passing into the office. No. 4 is for the foundry supplies used, 12 " x 6". Five columns for different fire and molding sands, then sea coal, coke facing, fuel, brick (two columns), clay and miscel-

laneous. No. 5 gives the monthly expense card, 6" x 4". Spaces are left for sand, metal, fuel used, the percentage of fuel to iron, the metal brought from yard, castings made, percentage shrinkage, number of castings charged up, average weight of castings, number of castings rejected, their weight, the percentage of rejected work, cost per lb. at cupola and supplies, labor cost, total cost per lb. No. 6 is the weekly expense card, 6" x 4", and gives the lbs. of sand, castings good, castings bad, percentage of rejected work, the molding cost per 100 lbs., core making, scratching, molder's helpers, furnacemen, miscellaneous help, total non-productive labor, pattern shop, total cost per 100 lbs. Finally, No. 7 gives the semi-annual report, 6" x 4". As an actual example of a prominent western foundry, this is given: Sand used 2,562,245—41 per cent.; metal melted 9,127,500; fuel used 1,389,-220; the per centage being 6.5 to 1; metal brought from yard 6,409,580; castings good 6,224,187; percentage of shrinkage, or melting loss, 2.9 per cent. Number of castings charged up as good 18,542; average weight 335 lbs. Number of rejected castings 544, 129,130 lbs., equal to 2.02 per cent. Cost per lb. in cupola .00762; supplies .00079; labor cost .00748 without pattern shop. With pattern shop it cost .00859. Total cost per lb. .01696; with foundry expense .02116; with pattern shop expense .02165, or 2.165 cents per lb.

CHILLED CAST IRON CAR WHEELS.

The Iron Trade Review, April 24. In a paper read before the students of Purdue University, Mr. E. H. Vannier describes the modern method of making car wheels of cast iron. During 1901 there were about 12 million cast iron car wheels in service in this country, weighing about 3½ million tons. In progressive car wheel foundries all the pig iron is bought under chemical specification. The iron is mixed and melted in cupolas having a rate of melting of about 20 tons an hour, some of these continuously for 8 or 9 hours. Test pieces are cast from the metal as it leaves the cupola; the chill in these should be 1" to 1¼" in depth. Two men prepare the molds and pour iron for from 18 to 20 wheels for a day's work. The molds are now described to the student. A wheel is usually guaranteed on freight cars for from

4 to 6 years, and for passenger service from 60,000 to 75,000 miles before worn enough to necessitate removal. The iron should be poured as rapidly as possible, a 600 lb wheel being poured in 15 seconds. After the wheel has remained in the flask for 20 minutes it is taken to the annealing pit, where, with some 12 to 20 others the initial heat is supposed to anneal them, being left in the pits from 4 to 6 days. The next process is to measure the circumference by a steel tape, their weight taken, and otherwise inspected. They are now subject to two tests, the drop weight and the thermal (each of which has been often described in these reviews.) In connection with the history of car wheels it seems that the earliest ones date back to 1800. The modern tendency is toward heavier wheels.

STEEL CASTINGS AND THEIR TREATMENT.

The Iron Trade Review, July 10. Mr. W. M. Carr discusses the production of steel castings and their treatment. Attention is always given the proper preparation of the molds and casting therein of the metal, but the final treatment of the finished casting is by no means as good as it should be. Brittleness and coarse grained structure in the casting is the result of imperfect heat treatment, in fact the maximum ductility and toughness of the castings will depend upon this factor more than anything else, with a proper composition to start with.

CAST IRON CAR WHEELS.

The Age of Steel gives the report by a committee of the Master Car Builders' Association in regard to the cast iron car wheel. Considering the discrepancies in weight of wheels used for the 100,000 lb, steel cars, further study is required to see what the development will be in the next year. In view of this the Committee recommends the collection of information, giving the weight of wheels, the capacity of cars, character of breakage of wheels that failed, track circumstances so far as grade is concerned, with full information of use to the Committee in studying the problem.

SNAP FLASK WORK.

The Tradesman, June 15. Mr. E. H. Putnam discusses a variety of things in his article headed "Mechanical Bigotry," and among

these the development of snap flask work is worthy of special attention. The snap flask is one of the most valuable devices ever introduced into the foundry. It requires practice and study on the part of the foundryman to get the utmost value out of it. Formerly the "snap bottom board" was made equal with the outside dimensions of the flask, but now the "squeezer" has cut it down to a size slightly smaller than the inside of the flask. This means a gain of two inches between the molds set upon the floor, a better mutual support, and less "run-outs." The next thing was a reduction of space between the pattern and the sides of the flask, and then where the castings are heavy, bands of steel are placed inside of the flask and are dropped out with the mold, preventing it from spreading when poured. At the present time the molds may be packed closely together, the weights being duly shifted, where the kind of work allows it, and boxes only used where bands will not be a sufficient safeguard. As a rule an inch space may be left around the pattern for the sand wall. The economy of the snap flask method is seen when it is remembered that fifty molders putting up 100 molds each would mean 5000 flasks of the ordinary kind instead of 50 snap flasks.

STARS.

The Tradesman, July 15. Mr. E. H. Putnam enlarges upon the great value of "stars" in the cleaning department of the foundry. There is hardly a corner of a casting into which the long hard points do not penetrate, scratching off every particle of burnt molding and facing sand. Mr. Putnam suggests that founders who have no star patterns purchase say 100 lbs. of them from a malleable iron works, then pick out as many good ones as it is desired to mold up in one flask, say 66 to a 10" x 15" flask. Ram up a drag on a smooth, level followboard, roll over and imbed the star castings in the joint by pressing them down to the parting line. Ram the cope on this, remove it, draw the patterns, build up the outer part of the joint of the mold to produce ¼" thickness, and cast. The result will be a metal plate, with half the patterns on the drag side and half on the cope. For the benefit of those molders who desire more detailed information on this point, Mr. Putnam goes into the minutiae of the process in his article.

TEST BARS.

The Ironmonger, June 14. Mr. Robert Buchanan arraigns the test bar in scathing terms, holding that it is in no sense a true indication of the value of the casting it is supposed to represent, a fact which every experimenter in cast iron has come across. He gives tests in which the same iron cast under different conditions gave a variation in strength of 17 per cent. Another case of a coupon test; one strip was almost three times as strong as another. Inasmuch as a bar cast on a casting was always found weakest, while the separate bar was strongest, Mr. Buchanan concludes that the coupon bar is nearest the real strength of the casting. This conclusion may be in accordance with Mr. Buchanan's observations, but is considered too unreliable in this country to base a system of testing castings upon. We rather work on the ground of knowing the metal that goes into the castings and using our best skill to see that it does not have its good qualities sacrificed in the casting.

SPECIFICATIONS FOR FOUNDRY SUPPLIES.

The Iron Trade Review, Sept. 18. The specifications for pig iron, molding sand, etc., used by the J. I. Case Threshing Machine Co, are now very well known. Mr. W. G. Scott, their author, has aimed to get the best class of supplies that can be obtained, and yet under simple and fair requirements. Here are the specifications for foundry iron :

	No. 1.	No. 2.	No. 3.
Silicon, not less than	2.50	1.95	1.35
Sulphur, not over	.03	.04	.05
Phosphorus, not over	.60	.70	.80
Manganese, not over	.50	.70	.90
Total carbon,	Not specified	.10	

Below these figures for silicon, or .005 above for sulphur means rejection. The American Foundrymen's Association standardized drillings are used as "standards," and Mr. Scott gives his method for determining the composition of the iron.

For the coke used the following is specified :

Moisture, not over	1.50
Volatile matter, not over	3.50
Fixed Carbon, not under	86.00
Sulphur, not over	0.75
Ash, not over	11.50

Coke which has over 0.85 per cent. sulphur, .05 phosphorus,

less than 85 per cent. fixed carbon, or less than 5.00 ash will be rejected.

On the sand question the following is given : Silica sand must not run below 95 per cent. in silica, or more than 4 per cent. alumina and 1 per cent. lime. Molding sand is classified according to fineness, and the following limits as to composition are given : Not over 1.50 carbonate of lime for iron castings and 2.25 per cent. for brass work, similarly not over 5.5 per cent. and 7 per cent. of iron respectively. Organic matter not to be over 1 per cent. and alumina not to be over 13 per cent. Core sand should not have over 5 per cent. of alumina and 2.5 per cent. iron. A series of specifications for gray iron castings are also given, and these will be reviewed later, or in connection with other matter in the same line.

PHOSPHORIZING METALS.

The Aluminum World, Mr. E. S. Sperry gives a good method for treating phosphorus intended to be dissolved in a bath of melted metal. It will be remembered that phosphorus is a dangerous thing to handle, on account of its high inflammability. Until used it must be kept under water. To overcome this difficulty the stick phosphorus is copper plated, thus : dissolve one pound blue vitriol (sulphate of copper) in one gallon of cold water. Place the stick phosphorus in this solution and leave it long enough to secure a good thick coating, moving the sticks about from time to time to get every portion covered with the copper precipitate. Before using leave the plated sticks in the air for half an hour to dry thoroughly. Insert into the melted metal by either tongs or a plumbago phosphorizer. As the amount of phosphorus actually getting into the metal is somewhat uncertain it is better to make a rich phosphor-bronze alloy in the first place, determine the phosphorus in it, and add to the required metal in the proper amount.

TO PREVENT "RAT TAILS."

Iron Molders' Journal gives a molder's remedy for these unsightly blemishes in the product of the stove foundry. Where work is "returned" use cement between the heavy and the light facing; that is, first heavy facing, then cement, and then the light facing. Where no facing is used at all use one shovel full of slacked lime to 16

shovels full of sand, mix well and run through a fine riddle and use just enough of it to cover the face of the plates. If non-effective use more lime. It will do the work.

A METALLURGICAL PROBLEM.

The Tradesman, Feb. 8. Mr. E. H. Putnam came across a remarkable series of occurrences in his foundry in making small castings, such as fittings, etc. The illustration possibly shows it best, as the photo-engraving was made directly from the castings at the time.

The white spots are very peculiar, being in a measure partly surrounded by gray material. These white spots were not in all the castings, but in so many that there must have been some potent reason for their existence. The analysis of the white and the gray portions is as follows (two separate samples):

	White	Gray	White	Gray
Combined carbon	3.35	1.35	3.25	1.20
Graphite,	.26	2.32	.19	1.90
Silicon,	2.55	2.36	2.43	2.32
Sulphur,	.139	.143	.137	.137
Phosphorus,	1.057	1.079	1.066	1.100
Manganese,	.26	.27	.24	.25

From the high amount of sulphur present it will be seen that there must have been a tendency to chill from that cause alone, yet the fact that gray portions of the casting often surrounded the white

entirely made this explanation seem a little doubtful. The phenomenon has been observed by others. Mr. W. Whitney writes that he has often met with it unexpectedly also. He hopes to solve the difficulty by metallographic methods. So far there has been no satisfactory explanation, and the case is given to our members for their information and possible solution.

CUPOLA LININGS.

The Age of Steel, Sept. 20. Mr. Walter J. May writes in the "Mechanical World" on this important subject. The outer ring of brick in the lining is usually laid flat in England, the inner lining from the bottom to the charging door is composed of arch bricks set on end. These arch bricks, however, being hard to get out, it is best to put in two to six plain fire brick courses to pull out readily in repairing. For the tuyere openings Mr. May recommends cast iron blocks extending a half inch inside the lining, claiming that they are not injured during the melt on account of the cold blast passing through them. He also recommends a cast iron ring for the top of the inside lining to protect the brick from injury due to the falling pieces of pig iron. For the binding material of the lining gannister is recommended, which, although dearer, is so much more durable. The lining is supposed to dry for a week, and then a gas coke fire lighted to gradually warm it up. Finally before melting, a layer of gannister of the consistency of putty is to be worked over the lower part of the lining about ½ " thick just over the melting zone, and 1 " thich at the bottom. This protects the brick from the heavy strain of the first melt.

SCABBING.

The Tradesman, May 1. Mr. E. H. Putnam writes of the various causes for scabbing. Mr. Bury had written in the "Foundry" that excessive application of the trowel on the face of the mold had a tendency to disturb the particles of sand, which caused washing off in patches, leaving scabs. Mr. Putnam holds that this effect is there, but more from overslicking, being in reality a hard ramming. The sand is compacted so strongly that steam generated cannot pass off freely, and the result is a displacing of the mold in the line of at least resistance, or inward into the mold cavity. After all hard

ramming is a relative term; what might be too hard over a high projection in the cope might be too soft on the drag side of the same mold. A mold hard rammed all the way through would probably cause a blow, To prevent blowing the gases must be able to flow off freely to a depth sufficient to insure recondensation by contact with the sand at normal temperature. Where the recondensation is inadequate through cores or pockets, proper vents must be provided. In many instances the sand is so close that it naturally causes scabbing, in which case it is well to add sharp sand. Sea coal facing is also efficatious in giving the necessary porosity for the free and harmless flow of the gases.

COMPRESSION OF CAST IRON AND STEEL.

American Maufacturer, May 8. In connection with the designing of parts of the dissappearing gun carriages, it became necessary to make some compression tests on blocks of cast iron and of cast steel. It was found that the elastic compression of the two metals was practically the same, amounting to .0047 in. for cast iron; .0039 for cast steel and .0037 for forged steel, with a load of 400,000 lbs. on a rocker 12 inches wide. The compression extended for about 5 inches into the metal, produced no disintegration or permanent set, in fact the metal returned to a point beyond its original form when the load had been removed. The method by which this peculiar behavior was determined is described at length. The experiments were interesting in that they showed the reliability of the metals when under severe compressive strains.

ARSENIC IN BRASS CASTINGS.

American Machinist, April 10. Mr. E. S. Sperry, of Bridgeport, Conn., describes the value of arsenic additions to brass castings. Where zinc is used the oxidation of the molten metal is so strong that many particles of oxidized products are carried into the casting, being held there when the metals sets. The usual way to prevent this oxidation while pouring is to surround the stream with burning oil, the flame acting as a reducing agent. What is really wanted is a substance which oxidizes when in the air while pouring, which leaves no film on the metal, and which is used in small enough quantities not to affect the alloy. This Mr. Sperry found to be metallic

arsenic. The amount to be used varies from 0.01 to 0.25 per cent. the latter amount to be used only in extreme cases. For instance, with "bright" brass, containing 63 per cent. copper and 37 per cent. zinc, 0.05 per cent. arsenic is the proper amount to be added.

SAND MOLD FOR STEEL CASTINGS.

American Manufacturer describes the process used by H. B. Atha, of East Orange, N. J., for making molds capable of resisting high temperatures. After the mold is made a wash of the following composition is applied: Five parts of rosin, by bulk, are dissolved in 12 parts of naphta. To one part of this solution add two parts of naptha and 3 parts of carbonate of magnesium. The rosin serves to thicken the liquid sufficiently to hold the carbonate of magnesium in suspension for painting purposes. The carbonate of magnesium enters the pores of the sand, while the liquid goes to the interior of the mold. After painting with the wash, fire is applied, which leaves a hard crust of highly refractory properties in the mold.

STRENGTH OF WHITE CASTINGS UNDER HEAT TREATMENT

The Iron Trade Review, Aug. 21. In a paper read by Mr. A. E. Outerbridge, Jr., before the American Association for Testing Materials, the heat treatment of white iron castings is discussed, the instances cited going to show that it is possible to radically change the nature of such castings without making them truly "malleable" ones. An instance of over-annealing the chilled treads of car wheels is given whereby soft gray spots were produced. The process of annealing castings with a composition of ordinary mallable is now described, the difference, however, being that none of the carbon leaves the metal during the operation. Mr. Outerbridge therefore holds that this makes it quite a distinct metal, while "malleable" men who have done the same thing for years in emergencies think it only one phase of regular annealing work, but too uncertain to make a specialty of.

TREATMENT OF "CHILLS"

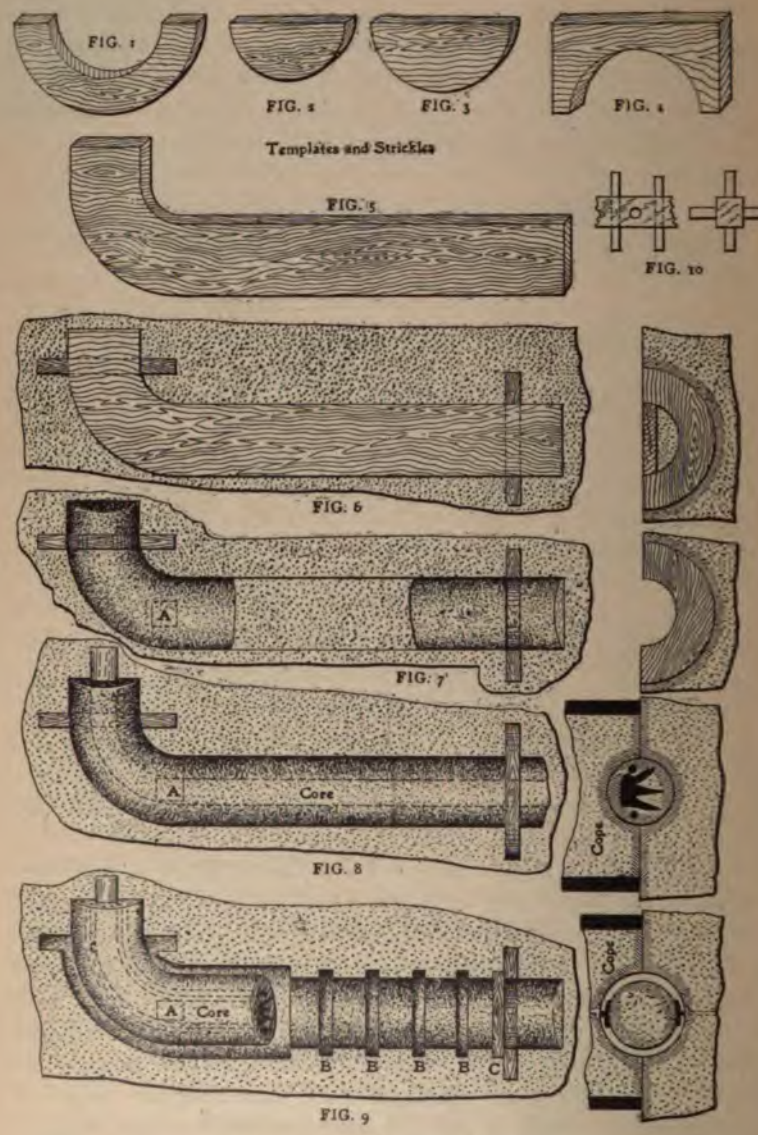
The Tradesman, June 15. Mr. E. H. Putnam tells us how to take care of chills and iron cores, so much used in the foundry. For

plow molds coat them with kerosene (carbon oil) after the mold is ready to close. Where very smooth surfaces are not required, any waste oil or grease is good enough. Where however, the chills are to act as iron cores their treatment is much more difficult. Where ample taper is provided for, simple oiling and coating with parting sand will work. Where the taper is only slight a painter's Japan is better, castings being not nearly so apt to blow with Japan. A very fine grade of sand is necessary, coarse varieties leaving unprotected spots.

MOLDING PIPES WITHOUT PATTERNS.

American Machinist, Oct. 2 Mr. F. W. Shaw describes a method of moulding pipes without patterns which allows moulding operations to begin immediately. Only time enough to make the necessary templates, strickles, etc., being required before. He says, "For the purpose of explaining in detail the method, I take, for example, a double-flanged bend or elbow. For this pipe, the patternmaker would make four-flanges, Fig. 1, cut to fit the core, two templets(true semi-circles);one (Fig. 2) the diameter of the core, the other (Fig. 3) the diameter of the pipe. If for a 3-inch pipe the former would be 3 inches diameter, the latter, say, 3¾ inches; one strickle (Fig 4)cut to the size of the core 3 inches in the supposititious case, and one templet (Fig.) 5 exactly the same shape and size as the lengthwise section of the core, *i. e.*, 3 inches wide for a 3-inch pipe, this templet to be about 3 inches longer at each end than the required pipe.

Fig. 6 to 9 show how to proceed with the moulding of the pipe. Prepare a level bed rather larger than the box part to be used, and bed in the core templet, with two half-flanges in position, level with the surface of the bed (see Fig. 9) . Now remove the templet and strickle the sand until the straight side of the strickle is level with the bed.. Fig. 7 shows this operation partly accomplished. Before finishing off this part of the mold it would be well to insert, some distance below the surface —a distance regulated by the length of stock chaplets—a block of wood to form a support for the chaplet. By the neglet of this simple matter, or by placing reliance upon the chaplet simply having its support by the pressure of the sand upon it, much trouble might, and often does, ensue. This block of wood



MOLDING PIPE WITHOUT PATTERNS.

can afterward be located by pressing in a vent wire and feeling for it Fill up the groove strickled out with first a layer of wet parting sand, then facing sand and then floorsand, and bed in it a core iron and ropes to form the vents, which ropes are to be withdrawn after completing the core. I have shown two vents, one of which, however is provided only as a safeguard in the event of one becoming blocked up. In order that there may be no liability to disrupt the core in drawing the ropes, it is better to insert two short ropes for each vent, overlapping where they meet at the bend of the core.

Complete the core, as shown in Fig. 8. piling up the sand and striking it to shape by means of the strickle, Fig. 4, care being taken the while that the top half matches the bottom one. Smooth the core and cover with a thick coat of wet parting sand. Withdraw the venting ropes and plug up the vent holes to prevent them becoming filled with sand while running up the cope. Fix on the other half-flanges and spring them in position. Fix on the cope and ram up as usual. Remove the cope and then the core. Now loosen the sand at intervals along the mold and stamp in the templet, Fig. 3, care being taken that it is stamped in concentric with the mold in which the core was made. At C is shown the templet not removed, and B B are the grooves formed by this templet. Cut away the sand between the grooves, using the templet to insure a correctly joined mold, and similarly in case of the cope. The left-hand half of the sketch shows the core fixed in position on the finished mold resting upon a chaplet A, and the end view is a section of the finished mold with the core in position and covered. The mold will be vented, and runners and gates and risers made in the usual manner.

Although I have shown a flanged bend or elbow, the method is available for pipes of every description, straight, bends V's, Y's, T,s, either flanged or socketed; but in the case of socketed pipes, although not absolutely necessary, it is advisable to have a socket pattern in halves made. The appearance of the pipe of course depends on the dexterity or want of it, as the case may be, of the molder. The core being made in green sand will not be so firm as a dried loam core, and care must be taken to get it by the well—but not too well—using of the trowel."

MOLDING BOSSES ON CASTINGS.

American Machinist, Aug. 7. Mr. John M. Richardson illustrates a number of ways in which bosses can be put on patterns so that they can be withdrawn from the mold. Fig. 1 shows two bosses on a pattern which is in halves and having the interior cored out forming a shell. The pieces are simply wired on, and, after each half

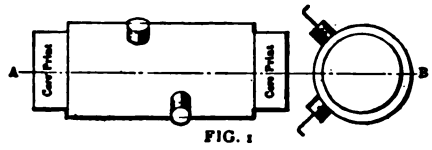


FIG. 1

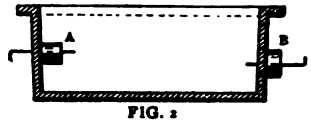


FIG. 2

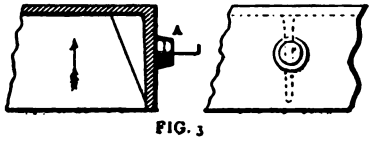


FIG. 3

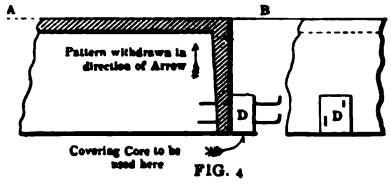


FIG. 4

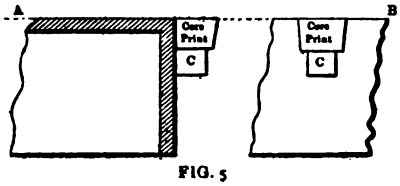


FIG. 5

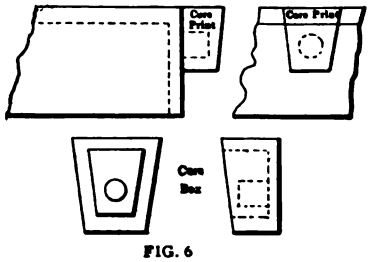


FIG. 6

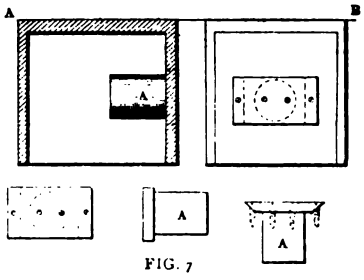


FIG. 7

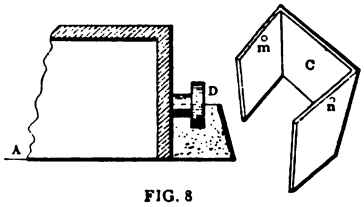


FIG. 8

of the pattern is removed from the mold, the loose pieces are withdrawn. Fig. 2 is supposed to represent a pattern of some considerable depth, with both interior and exterior projections, A and B, where the entire inside is lifted with the cope. The bosses here can be of almost any size and length without causing trouble; for, when the wires are withdrawn and the cope is lifted A comes with it and is then removed, while B is taken out after the pattern is drawn, coming into the large cavities thus left. Fig. 3 shows a boss attached loosely with a wire, but in two parts. The example taken is more favorable for this method than are the others shown, for the piece to be drawn is tapering on the sides, and there is a rib directly behind it, which leaves plenty of room to insert the draw wire. The body of the pattern is supposed to have a flat cope, and to be drawn out in the direction of the arrow. Fig. 4 shows a case where a pattern has a boss even with the lower edge and a covering core is used. The pattern is placed with the edge AB on a mold board, and is rammed up to the top level of the boss D, which is then removed; a flat covering core is placed over the cavity and the ramming of the nowel is continued to completion. After this the flask is turned and the cope, which is flat, is made. The entire pattern is in the nowel, and the pattern is drawn in the direction of the arrow. Fig. 5 illustrates one of the commonest methods of managing ears, lugs, etc. by means of a core print reaching from the top of the boss or lug to the parting line of the mold. If the boss was round it would have to reach to the centre, and half of the boss would be made up in the core box. The principle indicated in Fig. 6 also is often employed, having the entire projection formed in the core. In such cases a block core print larger than the boss is attached to the pattern, and the boss itself is placed in the core box, matching the print. The dotted lines shown within the core print in this figure show the position of the hub on the pattern. This way is more commonly used when the boss is either round or of some peculiar shape, and when it seems desirable for some reason to avoid loose pieces. A core is also often used when there are a number of projecting spots just alike in size and distance from the parting line. Fig. 7 shows a case which would not be practical except on a large job. The conditions are that the pattern is of a shell or box character, with walls and a large hub on the inside. The pattern is to be drawn in the same direction as Fig. 4, and placed on the mold board and rammed up in the same

manner, but no cores of any kind are to be used. A rectangular place is cut out of the wall of the pattern larger than the hub, and beveled on the two ends. A piece is next made to fit this, with its ends beveled to match and held with screws, having the boss fastened to its centre with screws. In ramming the pattern after the hub A has been covered to some depth, the screws are loosened from the outside, and the cover piece with the attached hub is removed. The hub itself is now unscrewed and the cover piece is screwed back in place, when the molding proceeds as though there had been no hub at all. Still another way to manage a projection awkward to mold is shown in Fig. 8. It is by means of an iron draw-back or pocket shown in perspective in C, and placed in position against the pattern at D. The edges next the pattern are beveled to a knife edge, and the top of the drawback comes to the middle of the boss. It is put against the pattern, which stands on the mold board at AB, and is filled with sand first; then the entire outside of pattern, and pocket or drawback as well, is rammed up, and when the flask is turned and the copies made and lifted the pattern can be capped and the pocket drawn first, which gives ample space to clear the boss, when the body of pattern is next withdrawn. Two small holes in the edge of the pocket at mm provide a means for lifting it.

COMBINATION IRON FLASKS.

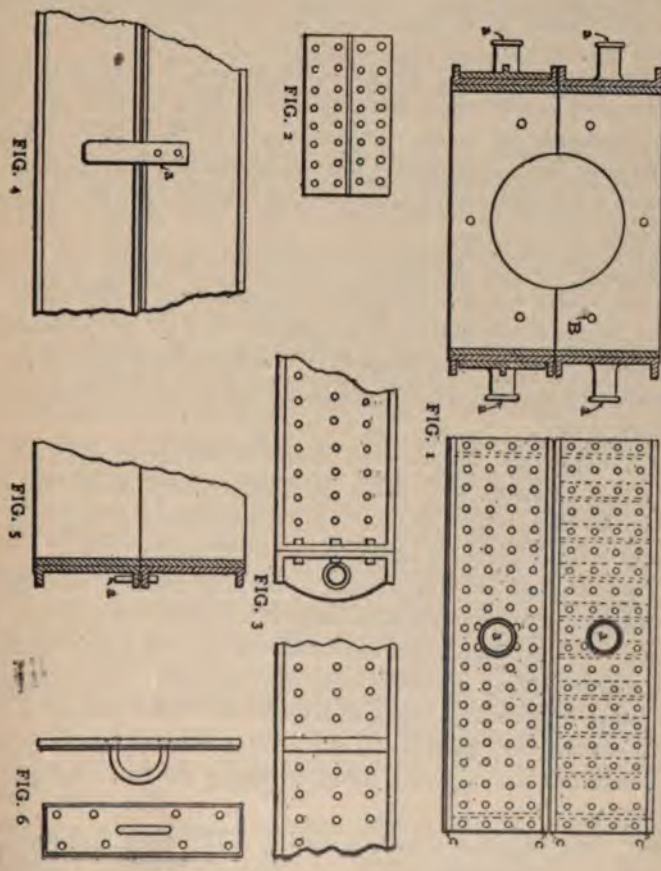
American Machinist, Aug. 7. Mr. R. H. Palmer illustrates his method of building up iron flasks in such a way that they can be easily altered.

Fig. 1 shows an iron flask bolted together at the corners, the sides some 5/8 inch thick, with flanges or ribs on each of the sides; these ribs are set back from the edge about 1/8 inch, while there are four rows of holes and trunnions. The ends are plain, with flanges at each of their ends to bolt the sides against. The holes in the sides not used for bolt holes to fasten in bars, form vent holes, and by having them in lines the bars may be placed to meet the pattern as required.

It will be seen that the end is left with a large, round opening, as there have been pipes made in it. Bolt holes B also are seen; should occasion require, a plate made in open sand with holes in it can be cast and bolted against the ends of each half to close the hole. The flask sides were drilled for pin holes in the ribs C, so that one may

place one half on top of a cope and make a three-parted flask, or as many parts as he wishes ; then the holes often come handy for bars in a cheek. In leaving the rib back from the edge a fraction of an inch it forms a chipping piece around the edge so that it can be easily chipped to fit together in case there is any rocking of the part on another. The bars in the cope are cast with a part of the circle cut out for pipe ; by coring a few holes in this bars, chucks are easily bolted in as required. As these holes are ½ inch, a number of spikes easily fill them and a wooden bar can be fastened in.

Fig. 2 shows a piece cast with holes to match those in the side of



the flask. If a flask is required longer, take out the end of one, butt it against a second, and use piece, Fig. 2, to tighten together, take short bolts out of the brass and use longer.

In making flasks which are wanted to be, say, 18 or 24 inches deep, instead of making the nowel or drag the full depth required, divide the depth in at least two or three sections. I have many times found it better in making a flask where a deep nowel was required to make it in sections, say, 8 or 9 inches in depth, or 8 and 12 inches, having holes bored so that when it was through with the job it was made for, if occasion required, the bolts holding it together could be removed and the same holes used as pin holes. Bars of the required shape were cast, and a shallow flask was the result.

In every jobbing foundry there is a certain run of work that seems natural to that foundry and that requires flasks of certain sizes, but varying principally in depth. A flask may be quite long and perhaps of slender build apparently, yet easily handled if arrangements are made to hitch on to it so as to properly balance it when hoisting with a crane.

In casting trunnions on a flask I have them made in a core, and set the core where I wish a trunnion, and ram it up in the mold.

On the larger flasks of iron an arrangement, Fig. 3, combining a staple to hitch into when rolling over a heavy cope, may be found very useful. In making it a rib is added on the pattern extra heavy with a core print.

Flasks of different lengths and width of the above style will be found very convenient. We have them from 30x36 inches up, and in the style of flask I have shown. If a smaller flask is required for green sand, drop a piece of board in the ends to close up.

In regard to pins for iron flasks, a foundry usually finds them quite expensive, even if a machine shop is a part of the concern. I have tried coring some holes in the side of the cope and casting a cast-iron guide A, Fig. 4, and bolting it to the cope. If one is broken it is easily replaced. I like cast iron better than wrought, which gets bent unless very heavy. If cast iron is used and gets broken (which I have not had happen), throw it among the bad castings and replace it.

Another style of pin is shown in Fig. 5. The same sized hole is bored in the cope and nowel flanges. The pin is tapered but very

little for three-quarters of its length, and near the smaller end it is tapered more. The larger end is simply too large to drop through the hole. I find the pin works very nicely and is very cheap. I had one turned out of wood and gave it to the molder, who cast it on end. We rattle them and they are ready for use.

Now, if in the flask where we use these pins we are making a casting requiring a long steady pin, we have a set of long pins made of common round iron, with one end an inch or two bent square over and the other drawn out a little, but not to a sharp point. We drop these pins through the holes in the top flange of the cope, passing down through the hole directly under in the lower flange of the cope and through the hole in the top flange of the nowel, and we have them as long as we wish. In some flasks we use ⅝-inch round and some ¾-inch, the holes being bored large enough for the round iron to pass through easily.

In making iron flasks they can be made quite light if well ribbed on the sides, but there is a limit either way. One often sees castings strained because the flask is not stiff enough to withstand the side strain, and the man making it does not realize the amount of strain on his flask and does not provide side binders, or top and bottom binders when there are lifting strains.

In providing for the handling of large flasks, I have been in the habit of casting a piece of casting like Fig. 6, making them of different lengths and sizes so that they could be changed from one flask to another, and bolted on to the sides of cope and nowel. In hooking into them and rolling over a large cope, it is better to wedge or block around the hook, but the size of the staple is regulated by the sizes of hooks on chains. Often a piece of rag wound around the staple will do the business, but the safest way is never too safe. I have the staple upset on the ends, have a rough pattern made the size I wish, burn out the holes for bolts with an iron, also the holes for the staple, set the staple in the pattern and mold. I had some cast with the staple just nicked, instead of upset, to keep from pulling out, but as the nicking was done too deeply the staple broke out and it came near being a bad accident while rolling over ; so I had rather have them upset.

In general, where light crane flasks are used, iron ends will be found very servicable. Once in a while you will find a molder who will not look at his cope to see if the bolts are tight, and who will

cuss the flask because he did not and because the flask cannot keep itself in order, but he is usually one of those men who find everyone to blame for their own carelessness, not themselves.

Considerable changing about can be done with iron ends as well as wooden. I have a flask in the foundry in use by one of the molders which was made from an old lathe-bed flask some 6 inches thick. It is fastened together by bolts extending from side to side outside the ends. The cheek was originally altered to some 6 feet 6 inches square by 25 inches deep and a tank was swept up in green sand in it, some 5 feet 10 inches in diameter by 25 inches deep. It was then unbolted and packed away. Later the sides were used, ends were put in and a pipe 15 inches in diameter was swept; this part was barred up for a cope for it. It has now been taken apart again, the ends as used for the tank have been replaced, and a ring is made in it some 7 or 8 inches in width, 12 inches deep on the inside and 8 inches on the outside, a green-sand core rising between the two, but the two are connected with plates on top of the core. Meanwhile the bolts did duty as binder bolts. I have some flasks made in the same way where the ends are not gained into the sides, simply butted against them, and where the ends have been moved back and forth according to the size of piece to be cast.

THE CUPOLA BREAST.

The Tradesman, April 1. Mr. E. H. Putnam holds the making of the cupola breast one of the most important points in cupola management. This can be readily understood when it is remembered that all the iron must pass through it.

Having formed the floor or bottom part of the breast, of uniform level with the sand bottom inside the cupola, and three-fourths of an inch higher than the lining of the center of the spout, take a mixture of one-half sharp sand and one-half fire clay, wetted to the right consistency, and wrap it around the smooth, slightly tapered iron bar with which you are to form the tap hole, and lay the forming bar thus surrounded with the coating of fire clay into the groove-scooped out from the middle of the floor of the breast, press it down till the bottom of the bar shall be three-fourths of an inch over the center of the spout, push it hard against the coke wall, throw in new molding sand and ram it in hard.

Take a molder's tool and form the front straight up and down. Withdraw the forming bar, and leave the edge of the tap hole flush with the front of the breast. Blackwash with plumbago in water. The blackwashing is important. True, there are many foundries where it is not practiced; and they get along tolerably without it some of them very well indeed. But the spatterings of molten iron cling with great tenacity to the hard fire clay and molding sand breast, making it difficult to keep it clean and intact. The breast ought to be in as good condition at the finish of the heat as at the start, and the blackwashing is a great aid to that end. With it, the iron can be readily removed from about the tap hole without crumbling or chipping away any of the sand from the breast, at the first few taps, and by that time the sand around the tap hole will become baked so hard that there will be no danger of damage from reasonable careful use of the tapping bar.

The spout, whether short or long, always should be well coated with plumbago wash. This will enable the removal of the solidified iron that may accumulate after putting on the blast and before the first stopping. If a refractory wash is not used, the iron is apt to cling so fast as to cause danger of seriously disarranging the lining of the spout, when it is removed.

Mr. Putnam again calls attention to the necessity of having the bottom of the tap hole ¾" above the bottom of the breast, as a tap hole thus constructed can be more easily cleaned out when obstructions have formed. Another point is to have the bottom and side of the spout lined with fire brick, as this allows some hard chipping to be done. The front of the tap hole should not be reamed out like a pouring gate, as otherwise the stopper will wedge itself too firmly. The stopping material is best made of one half fire clay, and one half molding sand, or varying proportions of each material. Fire clay alone is too strong, and molding sand mixed with flour, which is often used, is inferior.

LABOR SAVING MACHINERY FOR THE FOUNDRY.

Cassier's Magazine Nov. 1902. In an illustrated article on the above subject Dr. Richard Moldenke states that it is in foundries where thousands of castings of a kind are made that we find modern conditions aimed at. In the industrial war between nations, now becoming more and more acute, this will count heavily, for now that

inventive genius has been directed into the foundry channels, we find British, German, and American trade journals full of suggested improvements, as well as actual accomplishments in the line of rapid and cheap production of castings. To save one labourer the year around it pays to invest about $2000. How many labourers will one find about a foundry of some size who could be thus profitably dispensed with?

The various appliances about the power plant of a foundry which help cut down the running expenses need not be mentioned here. Any modern plant equipped with coal and ash handling machinery, or a gas engine plant with electrical transmission of power, will illustrate the point.

The core ovens may be provided with many an appliance which will facilitate the quick observation of the material within, allow a shelf-full to be withdrawn, without interfering with the continuity of the heat, and be so provided with flues and dampers that the temperature within may be sufficient to thoroughly dry, and yet be perfectly uniform too.

The cleaning facilities of the modern foundry have been augmented by the sandblast. British and Continental practice has been ahead of American in this respect for some time, many shops in Great Britain, Germany and Switzerland using this method of cleaning almost exclusively. Americans rather object to the too excellent cleaning of the castings. Too much poor moulding is shown up by it. On the other hand, the introduction of the sand blast has been a boon to the enameling industry, for the surface of a casting is left perfectly clean and especially free from graphite. The introduction of hydrofluoric acid for picking purposes is also a decided advance, the sand on the casting being dissolved, and not the iron under the scale, as when sulphuric acid is used.

Iron interchangeable flasks, core machines for making the round stock cores now seldom provided for by making special core boxes, moulding appliances which makes use of sweeps, and core appliances working on the same principle are only some of the many devices which help to make up a goodly sum total of money saved during the year.

It is the aim of every foundry foreman to get up useful contrivances in connection with the jobs he has in hand, and these soon become part of the institution. In going through the various foundries one

often sees a device for saving labour and insuring accuracy which commends itself at once. Given the larger appliances furnished by the establishment, these useful kinks frequently double their value.

To-day, more than at any time, the cry is for increased production at lower costs, and well-devised shop-cost systems in the office soon show where a modern foundry appliance is wanted. The engineer has placed at the disposal of the foundry-man labour-saving appliances which can find application in every part of his establishment, and his will be the fault if advantage is not taken of them.

GAS AND OIL FOR MELTING BRASS.

The Foundry. Quite a discussion relative to the use of oil and gas as the fuel in the brass foundry was carried on in several of the recent numbers of this journal. One correspondent found that it shortened the life of the crucibles too much. The makers of crucibles agreed that gas or oil as usually applied was not economical. One of them stated, however, that if used so that the crucibles were protected from the direct flame, and not too much air used their life was as good as when coke was the fuel. Another correspondent had tried a number of oils, but gave it up after noting how the crucibles suffered. The Westinghouse people, who made the most elaborate experiments in this line, got such good results from the use of gas and oil that they put in 20 furnaces of the tilting type equipped for gas and oil, and have doubled the life of their crucibles. An English firm found that to keep their crucibles in the best shape possible it was advisable to keep them hot continuously. They therefore put in an additional row of crucible holes for the crucibles not in actual service. This overcame the breakage due to leaving hot crucibles in contact with cold air.

CASTING ALUMINUM.

The Foundry, March. A few rules for casting aluminium are given by Mr. Harland Tuttle. Use sand as dry as possible. Avoid sponging a mold, better file the casting afterward than lose it. Use large sprues and gates ; cut them into the heavist part of the casting, and usually on top. Pour as rapidly as possible. Do not ram as hard as for iron. Vent all molds well. Pour as cold as possible.

FEEDING CASTINGS.

The Foundry, February. Mr. L. C. Jewett emphazises the fact that one riser, instead of a number of them, will pass more metal and consequently keep open longer. Better feeding conditions therefore result less help is needed, less liability to accident, less chipping afterwards, and less delays in handling the whole operation. The careful molder goes about the feeding process systematically ; he has located the riser where it can be fed easily, has his rods at hand and heated up properly. After casting he pushes the rod down to that it reaches about an inch into the casting, and no more, Feeding is done only a little at the time, so as not to increase the pressure on the mold too much. Moreover, by supplying hot metal often and a little at a time the metal in the riser is kept hot better and the rod remains clean, The result will be a satisfying job and clean mold. In working the rod it should be kept near the outer walls of the feeding head, the center remains liquid without trouble, The time to stop feeding is when the melted metal begins to assume a granular structure. Then it is time to fill up for the last time and after a few minutes loosen the sand around the riser. The job will be done.

GERMAN SILVER.

The Foundry, February. Mr. Percy Longmuir discusses "German silver," an alloy chiefly used in the electrical and table cutlery industries. The best alloy is probably : copper 48 ; nickel 30 ; zinc 22. As this, however, is rather costly, on account of the high nickel contents, other formulæ are used in foundry work. To produce sound castings the copper and nickel are melted in a new crucible under charcoal. When just melted the zinc is added, the contents of the crucible stirred with an iron rod coated with graphite, and when sufficiently liquid, poured into ingots. The ingots are broken up and remelted under charcoal and then "poled" so to speak ; that is, a piece of wood is attached to an iron stick and held at the bottom of the melt, causing it to boil violently, and in this way refining the metal. The crucibles are taken from the fire to do this, and are about three-quarters full. Large castings are best poured by arranging a basin over the gate and inserting a cast iron plug. When the basin is filled the plug is withdrawn and the metal flows through the gate clean. This is really a species of bottom pouring.

While alloys can be made with nickel varying from 30 down to 5 per cent., the following may be recommended: Where expense is no object, and a reliable German silver is wanted, use copper 60; zinc 20; nickel 20. From 5 per cent., to 10 per cent. lead reduces the cost. Iron added in the shape of wire hardens the alloy.

PATTERN METAL.

The Foundry, November. Mr. E. S. Sperry writes about pattern metal in the *Aluminum World*. After going through a number of alloys used in foundries and criticising them he gives the composition of an alloy which is used by a pattern making concern that gets 80 cents a pound for their work as it leaves the sand. Here it is: copper 90 per cent.; tin 6 per cent.; zinc 2 per cent.; lead 1.4 per cent.; nickel 0.6 per cent. This is really a steam metal with a little nickel in it. To duplicate this composition, the nickel being unneeessary, use copper 10 lbs (new); tin ¾ lbs; zinc ¼ lb. and lead 2 oz. For solder use 1 lead and 2 tin, or better still, braze with half and half brazing solder. Mold well in the first place.

CHEMISTRY AND CUPOLA PRACTICE.

The Foundry, October. Dr. Edward Kirk gives some sound advice to the chemist who wishes to succeed in the foundry. He cites many instances where difficulties come from improper melting and where chemistry is of no avail. This is a fact, for the chemist can only start a mixture right; the melter may spoil it afterwards. He therefore advises the chemist to become a practical melter. Dr. Kirk now goes into a number of points connected with melting iron, discussing the melting zone first. This is only 10 to 14 inches high, and the space in which iron is really melted properly is only 6 to 8 inches. It is about 14 inches above the tuyeres when coal is the fuel, and 20 inches when it is coke. When melting the charge of iron the fuel bed is lowered 6 to 8 inches. Enough iron only to do this should therefore constitute the charge. Then must come enough coke to raise the bed from 6 to 8 inches before the next iron melts. It is most important to have a proper bed of coke to begin with. For the single tuyere cupolas about 20 inches of coke above them is about right to have the bed to start with. Then iron three times the weight on this; after this a ratio of 10 to 1 should be held. Experiment will then indicate the best charges, keeping the iron at

a good heat. Under no circumstances use too much fuel in the cupola, as this is just as bad as too little.

DRESSING CASTINGS.

The Foundry, August. Mr. Percy Longmuir holds that castings should present an attractive appearance when shipped, and that this depends upon the treatment in the respective foundry. Apart from defective molding, bad trimming leaves unsightly castings. This is more so in brass than in iron castings. The vise and emery wheel is responsible for many distortions and changes from the round or hexagon forms originally in the casting as it came from the foundry. First of all the dressing up should be done in a properly constructed building equipped with efficient tools. Good benches, vises, and rattlers, but better still, good molding in the first place. For small brass castings the band saw speeded up as high as it will stand it is much better than the gate cutter. For the heavier castings, pneumatic chipping tools expedite the work very materially. Sand blast and picking in either sulphuric or hydrofluoric acid can replace the ordinary tumbling method if so desired.

PLASTER OF PARIS AS A BRASS FOUNDER'S FLUX.

The Foundry, August. While in ordinary brass founding a flux is to be avoided, if anything, yet where emery grindings, washings or buffings are to be remelted, plaster of paris will be found an excellent flux. To use it add four or five pounds to one hundred pounds of the metal, mix well and charge the crucible. When completely melted pour the whole contents into the ingot mold. The slag will rise to the top. Mr. E. L. Sperry, who writes the above mentioned article in the *Aluminum World*, states that the flux can be used over again several times and does not affect the crucible injuriously.

BURNING BRASS ON IRON.

The Foundry, October. Mr. J. F. Buchanan writes of the rather unusual job of "burning on" brass instead of iron where a defect was to be remedied. He describes a pump which was in so precarious a condition that burning iron on it would have been a failure. It was filled with sand dried and burned up the usual way, using small brass. Strange to say it takes less brass or bronze to burn a casting of iron than if iron is used. Naturally the brass must be

"jumping hot". A good composition is copper 16 ; yellow metal 6 ; lead 3; tin 1. Mr. Buchanan finally deprecates the use of fillers and rightly holds that if a job is to be patched up, burning it is more creditable to the foundryman than filling up. He therefore urges that "burning" castings should be studied up carefully by molders and that much work may be saved thereby.

EFFECT OF VARIATION IN CONSTITUENTS OF CAST IRON.

The Foundry, September. Mr. W. G. Scott, the well known chemist of the J. I. Case Company, in an elaborate paper recently read at the convention of the American Society for testing materials, goes into the behavior of the constituents of cast iron, under the various conditions met with, very thoroughly. After describing the methods he uses to insure reliability in his work he discusses the influence of silicon, and finds that it softens iron, imparts fluidity, decreases shrinkage, opens the grain, promotes the formation of graphite, and reduces the strength. Sulphur makes the iron hard, increases the shrinkage, promotes chill, causes the iron to congeal quickly, and gives rise to blow holes, shrinkage cracks and dirty iron. Phosphorus lowers the melting point of iron, imparts fluidity, decreases shrinkage, weakens iron and makes it brittle under shock. Manganese in large percentages hardens iron, increases shrinkage and chill, reduces the bending properties, tending to make the carbon combined. In small amounts it does the opposite of all this by its action on sulphur and the occluded gases. Combined carbon closes up the grain of the iron, increases shrinkage and chill and raises the strength, while graphitic carbon weakens the iron, reduces shrinkage and chill and makes a soft iron. Where specified results are wanted the following pointers are given : To raise the strength increase manganese, reduce silicon and phosphorus. To reduce shrinkage increase silicon and phosphorus and reduce sulphur. To prevent blow holes, reduce sulphur and increase manganese. To prevent kish, increase scrap in mixture or increase manganese.

MOLDS FOR STEEL CASTINGS.

Eisenzeitung, No. 40. To avoid the necessarily slow drying process for the regular steel mold made of silica, clay and coke, Mr. E. Sarg, of Malstatt-Burbach, Germany, proposes the use of ground

slate from the coal measures. Very smooth castings are said to be the result of using this material the formula for which is as follows: Slate from coal measures, 6; sand 3; coke ½.

CONTINUOUS ANNEALING.

The Iron Trade Review, Oct. 16. At the October meeting of the Foundrymen's Association of Philadelphia, Mr. J. H. Pepper read a paper on a new kiln for continuous firing, and suggested its use in the malleable industry. The kiln is about 123 ft. long and 24 ft. wide. Firing is done from the sides, the product to be burned or annealed entering at one end on suitable trucks, and coming out at the other. The idea presented is of course admirable, were it possible to carry it out effectively for malleable purposes. To the reviewer it seems doubtful whether the delicacy of the annealing process as required in the malleable industry can ever be attained by this adaptation of the glass house "lear". The heat of our present annealing ovens are far from uniform, which results in much trouble from under and over annealing. Again the rolling mechanism would necessarily be under the extreme heat influence, which means a short life. Finally the time required to anneal castings properly would mean a very long oven, the cost of which might be out of proportion to the results expected from it.

COST KEEPING IN AN OHIO JOBBING FOUNDRY.

The Iron Trade Review, Sept. 4th., gives a series of blanks in use in a foundry in which a variety of work is constantly going on. Fig. 1 gives the sheet used for the daily time report. Fig. 2 the daily summary of labor, in which columns are left for men's numbers, rate and hours. Then the molding, cores, direct labor and cleaning. Fig. 4 has the weekly list of material used such as sand, blacking, facing, flour and molasses, with spaces for each day of the week. Fig. 3 gives the summary of work in the melting and drying departments. Fig. 5 the melting and core oven cost for the month. Fig. 6 gives the cost sheet of the month and so arranged that this month, last month, to date, and last year is shown. Averages and totals give a ready oversight in the matter. Finally Fig. 7 gives a general charge sheet for the month. Office expenses, sundry expenses, cranes, cupolas, shop, etc., are all included here.

SPECIFICATIONS FOR CAST IRON PROJECTILES.

The Iron Trade Review, Oct. 16th. The specifications for cast iron projectiles has been amended recently by the Ordnance Department of the Army. The castings must be made base down for shell, and point down for solid shot, with a sufficient riser to insure soundness and density. 27,000 lbs. per sq. inch is required for sea cost projectiles, 25,000 for siege, 22,000 for field, and 18,000 for mountain projectiles. Specimens are to be taken from cylinders cast at the same time as the projectiles, two from each heat being ordinarily sufficient. Cracks, flaws, sand holes, etc. more than 2-10" deep will cause rejection. Spongy metal likewise. Steam or water pressure is applied finally at 100 lbs. per sq. inch for two minutes, leaky projectiles being rejected. The base plugs of shells to be of forged steel, of not less than 30,000 lbs. per sq. inch in tenacity.

COKE.

The Iron Trade Review, Nov. 6. In a paper read before the Pittsburgh Foundrymen's Association, Mr. N. P. Hyndman reviews the process of manufacturing coke. The serious condition of the coke market attracts special attention to this commodity just now. The distribution of the producing capacity is first reviewed. Then the claim that only in the Connelsville region could the proper coke be made is taken up, and it is shown that the drift mine producer sells his coke in the same market at all times. While formerly coke was wanted with the sulphur below .75, now 1 per cent. is taken without question. Much of the objection to poor looking coke is due to the "black tops," which after all are only signs of too quick coking in the oven. Black tops are not objectionable, but "black butts" are, as these are uncoked coal, due to damp bottoms in the ovens, etc. The 72 hour coke, which is burnt longer, is harder and better adapted for foundry work. Mr. Hyndman now describes the process of burning coke, and Mr. Stroh then discussed the question of coke as used in the foundry. He suggests care in proportioning the amount of blast to the coke used, that the quality be constantly watched and poor material rejected.

COST SYSTEM FOR FOUNDRY.

The Iron Trade Review, Oct. 2, gives the system in use at the United Engineers & Foundry Co's various shops, for keeping costs.

The card system is used wherever possible. Figs. 1 and 2 give the shop order card, both sides being filled up with data relating to the order. Fig. 3 shows the list of material for mill, office and contracting department. Fig. 4 is for the benefit of the foundry foreman, giving the data relating to the various heats. Fig. 5 shows the daily reports from the foundry. Fig. 6 further elaborates this by giving the product and consumptions of cupolas and furnaces. Fig. 7 is the delivery slip used by the shipping department of the foundry. Next come the slips in use for the machine shop. The whole makes a very complete series of cost records, and should be very valuable in the shops in question.

CAST IRON FOR SUPERHEATERS.

Baumaterialienkunde, No. 12. The Secretary of Commerce of Prussia recently requested the National Engineering Societies of Germany to express their opinion on the use of cast iron for the parts of boiler superheaters. The result of this inquiry was that "the data available at the present time show that there is nothing to prevent the use of cast iron for such purposes, provided the material is of the proper quality for the purpose." The Secretary of Commerce then requested the engineering bodies to recommend the qualities which cast iron should have to be used for superheaters, and the German Engineering Society is asking boiler makers and others for data on this point, for future publication.

STANDARD SPECIFICATIONS FOR CAST IRON PIPE.

The Engineering Record, Sept. 13. The New England Water Works Association recently adopted a set of specifications for cast iron pipe by unanimous vote. This goes to show that there is a very strong desire to standardize everything which is made in sufficient quantity to warrant such a proceeding. There are 20 sections to these specifications, and the ground is covered fully and admirably. Section 9 gives the method of testing the iron. This is by 26 inch bars 2 " x 1 " tested transversely flatwise on supports 24 inches apart. For 12 " diameter pipes or less these bars should support 1900 lbs and deflect 0.30 ". For larger sizes than 12 inch pipe 2,000 lbs is demanded, with a deflection of not less than 0.32 ". The average of three bars may be taken, and provisions are made for tests on bars other than the size given.

THE NEW PUBLIC LIB.
49

Journal of the American Foundrymen's Association

VOL. XI. DECEMBER, 1902. PART III.

FOUNDRY COSTS.

Engineering Magazine, Sept. Cost accounts are occupying much space in the technical press. Mr. Percy Longmuir discusses the method of recording them and then interpreting the results. The usual methods are discussed and criticised severely, it being held that essential information is lacking. On the other hand, where the information is very detailed, and the results from week to week are plotted graphically, the manager is able to determine at once where the trouble from excessive costs may lie. Mr. Longmuir gives a number of charts which show the fluctuations for the labor, molder, core maker, and other costs very forcibly. A good working line is given, a cautious line, a danger line, and in one case, a works was running below profit. For those who make a study of different methods of showing up details of cost, the article of Mr. Longmuir is recommended.

FOUNDRY QUESTIONS.

Stahl und Eisen, Sept. 1. In an address by Mr. Bernhard Osann, of Engers on the Rhine, delivered before the German Foundrymen's Association, he discusses the influence of American foundry practice on that of other countries. He depricates the usual practice of putting our foundry methods at the head of the industry, and thinks that we have just as many faults as others. He quotes the opinions expressed at the Buffalo convention of our Association, claiming that the opposition shown to the use of foundry chemistry proved his contention. Nevertheless, Mr. Osann emphasizes the fact that Germany must watch American foundry practice closely. He holds further that those of our methods which do not lead to economical results are carefully excluded from the press, which is hardly the case. However, Mr. Osann cannot praise our desire to interchange ideas too highly. He gives the "Foundry" a specially complimentary send-off, and even voices his surprise at the fact that the American, whom he supposes a "temperance" advocate, can get up such excellent "smokers" etc., as at the convention of

our foundrymen. American foundry methods are not to be imitated in Germany, but only utilized, for the conditions under which we work are entirely different. Mr. Osann now describes in detail our mechanical and metallurgical appliances, with which we are sufficiently familiar.

TESTING IRON IN SMALL FOUNDRIES.

The Mechanical World. Mr. W. J. May comments upon the methods by which iron should be treated in the small jobbing foundries. After discussing the undesirability of small foundries, he suggests the use of all scrap mixtures for these places. By sorting this scrap into soft, medium and hard irons, and throwing all unsortable material into piles for grate bar work, it is melted up in the cupola, using good coke and plenty of blast. Where the castings are to be machined, a little No. 3 foundry pig is recommended. Furthermore, it is advised to melt up the scrap and run into pigs, before using the iron for casting at all. We rather fear that this advice would mean pretty dear and hard iron eventually getting into castings, unless the English scrap is much softer than ours.

CONSTRUCTION TEST.

The Iron Age, Nov. 13. Mr. Asa W. Whitney describes his automatic chill test for cast iron. His aim was first to preserve a continuous contact of the test piece with the chill block, and secondly to indicate automatically the progression and extent of this contraction. Mr. Whitney uses the frustrum of a cone whose bottom diameter is 5 per cent. less than the top diameter. The test piece can thus easily drop out of the mold afterwards. The method he proposes is described at length, and would seem to be intended to replace the usual crude ways of determining the chilling capacities of an iron. We will await further developments of the matter before discussing it at length, as it is given by Mr. Whitney tentatively, he evidently being still at work developing the project in order to show practical results by its use.

"TRUSTS."

The Iron Trade Review, April 17, gives Mr. Charles Kirchhoff's address on the above subject, as delivered before the Philadelphia

Foundrymen's Association. He thinks that "consolidation" is the right word to use, the meaning of "trust" in the popular mind being one of the monopoly. As a matter of fact not one of the consolidations can ever be a monopoly, though they are certainly "dominant" in their respective industries. The movement toward consolidation is inevitable at the present day. What the ultimate effect will be remains to be seen. The fear of a monopoly in the iron industry is gradually disappearing, as no one corporation can control the mineral resorces of the country. Coal covers so vast an area that no one concern can ever own it. Ore is liable to be found anywhere, both in this country and in others. It is thought sometimes that the securing control of the richest deposits will give a monopoly, yet after all this advantage has always been at once capitalized and is therefore lost. The existing consolidations have large expenditures to make to keep their plants up to the standard set by the new independent plants, and oftentimes parties who have sold out re-enter the business to sell out again. The manufacturing capacity has been increased and the individual producer has not suffered. Unfortunately there has been much stock gambling going on, and this has given consolidations a bad name. The reduction of the number of individuals in an industry makes it much easier to get together to adjust difficulties. At first service was peculiarly bad owing to the confusion created, but this is now happily adjusted. The consumer, as a rule, will always give the outside producer the perference in order to foster competition. Then again the consolidations have adopted liberal policies, but have done away with many abuses formerly tolerated. To keep the plants running full the time will come that much export business must be done. This costs more, and very probably the domestic market must stand it, the consumer's market always making the prices. An interesting discussion followed the address, Mr. Kirchhoff's exposition of the advantages and disadvantages of the so-called "trusts" being considered very fairly stated.

FOUNDRY PROGRESS.

American Machinist, Nov. 6. Mr. Harris Tabor gives a very interesting story of recent foundry progress in connection with the anniversary number of this journal. Writing from the standpoint of the mechanical engineer, this development of the foundry from

the crude methods in vogue 25 years ago to more exact lines in use to-day has helped the machine tool builder to create the enormous demand for American machinery by reducing the shop costs. The wonderful advancement of the molder's art, Mr. Tabor says, is apparent on comparing the steam engine of to-day with that of a quarter century ago. The success of the foundry in America is due to specialization. The duplication of work has made it adopt labor saving methods. The molding machine has become part of the modern foundry equipment, and this has been vastly improved in recent years so that better facilities are now given the molders than was the case in former days. Mr. Tabor concludes with a plea for helping the "man behind the gun" in the foundry in order that this may retain its advanced rank among the industries of the world.

CALCULATING THE WEIGHT OF CASTINGS.

American Institute of Mining Engineers. Mr. C. M. Schwerin illustrates a new method of calculating the weight of a casting. Instead of weighing the pattern he takes the drawings, makes a blueprint, mounts this on a card bord and uses the planimeter on the section, which in connection with the general dimensions enables a pretty close calculation to be made. The method is illustrated by two examples. That of a 650 lb. car wheel which was calculated to be 649.93 lbs. from the drawings, and that of a 700 lbs. wheel came out 700 lbs. exactly. The method has the great advantage of enabling the designer to get a given weight without actually having the patterns and castings made by the usual cut and try methods.

ACTION OF LIGHT ON COLORED BRASS LACQUERS.

The Brass Founder and Finisher, Oct. 15. In the Journal of Societyfor Chemical Industry Mr. H. Smith discusses the lacquers applied to brass to keep it from tarnishing. Lacquer is known as "cold" and "hot" as applied upon cold or hot metal. "Cold" lacquer is a solution of nitrocellulose spread upon the metal with a brush just as in varnishing. "Hot" lacquer is usually seed-lac dissolved in methylated spirit. This lacquer is usually colored to get a gold or copper tint. To determine the lasting qualities of the various colors when exposed to sunlight a number of experiments were made with the following results: (1) Vegetable coloring matters such as tumeric, saffron, dragon's blood, annotto, fade completely. (2) Tumeric,

saffron and annetto also turn the brass black. (3) The aniline colors, metanil, yellow, ansamine, and primrose are good for yellow lacquers. as they do not turn brass black. (4) Dragon s blood is more suitable for copper colored lacquer than sandal-wood. (5) Gamboge is best suited for yellow and golden lacquers, as it does not fade or blacken brass.

INFLUENCE OF SILICON ON THE ANNEALING PROCESS.

Stahl und Eisen, No. 15. Prof. A. Ledebur gives some facts on the influence of silicon which are interesting to the maker of malleable castings. While it was formerly considered necessary to have a low silicon contents in the hard castings in order to properly malleablize them, it is now known that at least .40 per cent. is necessary, and that 1 per cent. is not dangerous provided no graphitic carbon is separated out in the casting. It has been proven that the carbon of the hard casting does not leave during the annealing process until the combined carbon has been changed into temper carbon. The easier this is accomplished the quicker will be the annealing process. To determine the effect of silicon on the process five samples were taken and heated under various conditions. The first sample, 0.07 silicon, could not be annealed at all. The second piece, with 0.27 silicon, took almost the melting point of iron to anneal it partially. No. 3, with 0.80 silicon, showed traces of annealing when heated up to 1675° F. No. 4, with 1.25, and No. 5, with 2.10 silicon (the latter having 0.2 graphite) showed annealing at the temperature of 1200° F. All of this goes to prove that the higher the silicon the easier is the change from combined carbon to temper carbon. Further experiments proved that the higher the silicon the lower the temperature required and the higher the temperature and silicon the quicker the change.

30 06

THE NEW YORK PUBLIC LIBRARY
ASTOR, LENOX AND TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. FEBRUARY, 1903. PART III.

CELLINI AS A FOUNDRYMAN.

In his *Little Journeys*, Elbert Hubbard discusses the "Memoirs" of this famous sculptor and artist in Bronzes. Those of us who have admired his masterpiece "Perseus", in Florence, will be interested to know that he minutely described the whole process of molding and casting this remarkable piece of Bronze statuary. The translation of that portion of his memoirs has it that he provided himself with several loads of pine wood from the forests of Serristori, and while these were on the way, he clothed the model with clay, specially provided for, and armored it with iron girders. He left numerous air vents, "the more of these, the better the mold will fill." Melting the wax model of his "Perseus" out of the clay, by slow fire, he constructed a funnel shaped furnace all around the clay mold, of brick properly interlaced, and with numerous air spaces for the fire to exhale. Then he burned wood in it for two days and nights. Being thus well baked, a pit was dug, the mold raised exactly over the center, and lowered down carefully. Now he banked it up with the earth he had dug out, placing numerous drain tiles for air vents in it. The furnace was next charged with pigs of copper and other bronze stuff, according to the "laws of the art," and then he let her go. The roof caught fire, and the rain and tempest raged without, and he proceeded to get deathly sick. Instructing his gang of master founders, etc., what to do to make the cast, he placed himself in the care of his housekeeper. Battling with the fever for two hours, he saw a vision of a man doubled up in the shape of a capital S, who told him that things were in bad shape outside. Upon this he "shrieked loud enough to be heard in hades" and started to dress, assisted by the several members of his household, whom he kicked and cuffed ad libitum. Taking charge again, he found the heat "curdled," though he says the

technical expression was "caked." Piling up a lot of oak logs, which, he has it, heat most powerfully, in contradistinction to pine and alder, used preferably by the "gun foundries" where they want "slow fire," he next flung a half pig of pewter on the frozen bath. Between this and the oak fire, he soon got it liquified again, and "having brought the dead to life again against the firm opinio of those ignoramuses"--by way of referring to his master foundrymen--he proceeded to tap. The stream not flowing as it should, he placed all his pewter dishes along the spout and in the furnace, and got a successful cast. In the meantime his furnace had exploded, but did not seem to bother him, and some of the gang were putting out the fire on the roof, and closing the windows with carpets against the rain. He also got well. The maids were sent out to buy earthen dishes to replace the pewter, and a most remarkable piece of bronze statuary was saved to the world. For a period about 1540 this is not bad foundry practice, and the famous Benvenuto Cellini was doubtless a prominent member of the local Foundrymen's Association.

FOUNDRY ACCOUNTING.

The Brass Founder and Finisher. Mr. Kenneth Falconer contributes an admirable series of papers in this Journal on a subject which is attracting more attention every day. His axiom that no results can be more accurate than the data they are compiled from will be readily conceded, and it seems that every attention should be given to procure these data in as reliable a way and for the best purposes possible. Writing more from the standpoint of the brass founder, Mr. Falconer explains the manifest impossibility of keeping cost records on each article manufactured. The molder and his helper may be working on cored and they may be making solid castings. The melter similarly on metal for machine and for tub castings. The materials will vary in many classes of castings as well as in the labor expended in fitting up, etc. If, however, we charge up all the cored work with the core room cost, and the pattern shop only to castings made from the firm's own patterns, we will get a correct distribution of these items at least. Where the foundry is part of a manufacturing establishment, its accounts should be treated as if it were an outside concern. A foundry account should be opened, all material, expense, supervision, etc.,

should be charged to it, and all material received from the foundry credited. If the work can be classified, let us say into four qualities, then there will be four sub-heads under six general headings. First, castings made on the molding machine, either cored or not cored, four divisions of each. Next, a general class of castings hand-made from home patterns, either cored or not cored, and finally, castings hand-made from customer's patterns, either cored or not cored. Twenty-four divisions in all. The information is all given in symbols. Thus, B-2-4, denotes that the castings were made from home patterns by hand, were solid, and of the fourth grade. The labor accounts are interesting. Under material accounts we have sub-accounts for metals, crucibles, and miscellaneous. There are accounts for special stores, fuel, manufacturing and gates. The last named divided into the four qualities above mentioned, and the manufacturing into the twenty-four divisions previously outlined Now come accounts for defective castings, bad castings, maintenance, stores, expense, product and revenve. The accounts for defective castings and product are divided into the 24 classes aforesaid. An important point brought up is the attention to be given to the metal yard, especially the scrap, if much of this is used. The loss and wastage here would surprise those who care to look into it. A good system of finding patterns should be introduced. The output of the foundry being carefully controlled, we can arrive at the total weight of the four qualities of castings here assumed, and dividing these weights into the total cost of each we can get a factor cost per 100 lbs. of castings for each class. The separate items can now be distributed properly. We now get in all 36 factors of cost. Thus :---Four for metal melted for the four qualities of work. Then come crucibles used, fuel consumed, other supplies, firemen's wages, two factors for wooden boxes for cored and solid castings, wages of furnacemen. Four factors for molders' time on hand-made castings, and four for machine made. Two factors for wages for storekeepers and helpers. Core room wages, core room supplies and cleaning room wages. Four factors for the classes of pattern repairs, bad castings from cleaning room, bad castings from storehouse and elsewhere. Three factors for maintenance in foundry, cleaning room and core room, and finally the proportion of fixed charge and general expense. All these items are distributed in the cost of the 24 items assumed in the

first place, such as A24, C21, etc. In this way the cost can be picked out neatly and improvements to the plant will at once show themselves. Costs can be figured out so closely that intelligent bids can be made at once and non-profitable work rejected. Mr. Falconer now goes into the general tabulation, monthly cost statements, and graphic diagrams of the figures obtained. While this looks very elaborate, it is really very simple once it has been introduced. Stationery is cheaper than time, and where suitable blanks are provided the work comes along quickly enough. The reader who may be interested will find these three articles in No. 6, 1 and 2, 1902, of the Journal in question of great value.

CASTING IRON ON STEEL SHAFTS.

American Society of Mechanical Engineers: Mr. F. V. Henshaw holds that the following conditions must be fulfilled in order to secure a tight joint. 1. There should be a considerable body of cast iron surrounding the steel. 2. The steel rod should be heated before pouring the iron on, the temperature being raised to a point slightly below visible red. 3. The surface of the steel rod should not be too smooth, and it is recommended that it be roughened up by small nicks cut with a cold chisel. Mr. Henshaw thinks that the trouble experienced with loose joints between steel shafts and the cast iron surrounding them, is generally due to the shaft being cold when the iron is poured, and there being too little iron surrounding the shaft. Also that the roughening of the surface of the steel is of great importance.

FOUNDRY FACINGS.

The Iron Trade Review, Dec. 4. Mr. T. E. Malone reviewed the history of making foundry facings, and showed the necessity of letting this important matter become a specialty of its own. In his paper, read before the Pittsburg Foundrymen's Association, he states that in the Pittsburg district sea coal facing is mixed with sand in the proportion of 1 to 7 to 1 to 14, depending upon the thickness of the castings to be made. There is much importance to be attached to getting an intimate mixture for the facing sand. It goes without saying that the sea coal should be finely and evenly ground. Plumbago, or graphite is another facing, the Ceylon variety being by all odds the best. Soapstone also forms a small item

in this line, being used with plumbago to cheapen it, or alone.

FOREIGN FOUNDRY PIG IRON.

The Iron Age, Dec. 25. A letter of inquiry was sent out by this Journal among Eastern foundrymen asking for their experience with foreign irons. Strange to say over one half of those asked, who presumably would be the ones to buy the foreign irons, stated that they had obtained enough domestic pig to meet their requirements. The replies from those who actually used foreign irons make interesting reading. Those who mix by analysis only seemed to have had no trouble, due precautions having been taken to keep the proportion of scrap carried suited to the composition of the new irons. Where the founders used analysis and grading, the ear marks of trouble are seen, for the two will not fit together. On the whole, however, the reports show that the laboratory is being generally used, and that pig iron, whether foreign or domestic, if well made, need offer no obstacle to successful use anywhere, if mixed on a scientific basis.

SEA COAL.

The Iron Trade Review, Dec. 4, gives Mr. E. Frohman's paper on bituminous facings, as read before the Pittsburg Foundrymen's Association. Sea Coal—this most important foundry commodity—was originally made from coal mined under the sea. Even today it is thus obtained in Wales. The best sea coal, however, comes from the high gas coals in Westmoreland Co., Pa. Whatever may be the reason that castings peel off nicely when a facing of this kind is used, the fact remains that they do so It is necessary to grind the coal finely and uniformly. The usual process is to crush the coal, wash it, then dry at as low a temperature as possible, then grind again to the required fineness. Sea coal should be free from sulphur to as great an extent as possible, be low in phosphorus, and high in carbon and volatile matter.

NOTES ON EUROPEAN FOUNDRY PRACTICE.

The Foundry, December. Mr. G. E. Pickup writes very interestingly on some of the things he has seen while touring Europe, more especially England, on behalf of his firm. While advanced shops are by no means uncommon, yet the majority of those mak-

ing light castings still plod on in the same old way. For instance small iron flasks are used and patterns are ungated even where the castings are made in considerable quantities. The Molding Machine and snap flask has done much to improve the output. The great difference between English and American practice seems to lie in our specialization. We make specialties, and these in very large quantities at a time. On the other side they have splendid shops for general work but little facilities for specializing. The cupola practice is also very far behind in Europe, elevators being little used and the cupolas rather primitive affairs. Judging from the difficulty of getting into Belgian and French foundries of antediluvian date and appearance, there must be a great anxiety to preserve trade secrets, which however does not prevent America from putting castings down on their shores for less than the continental shop cost.

THE RISER.

The Foundry, December. Mr. A. M. Loudon discusses the much mooted question whether the riser should be left open or be closed. He claims that it is better to leave the risers open to allow the gases to escape freely. Any foundryman can prove this to his own satisfaction by pouring two castings, one with the riser open, and the other with it shut. The latter, on machining, will show gas holes near the surface, while the former will be free from them. There is no necessity of keeping the mold under even the slightest pressure and many a casting shows what are called "dumb scabs" and dirt collected a few inches from the joint as a result of insufficient freedom in the risers. Mr. Loudon quotes instances which go to show that there is nothing in the theory of the "down draw" in a mold with open risers, and hopes that other practical men will discuss this matter at further length.

SAVING THE SCRAP PILE.

The Iron Trade Review, Dec. 11. At the December meeting of the Philadelphia Foundrymen's Association, Mr. Ward, of the American Brazing Co., made some interesting remarks on "Ferrofix," the German flux, containing oxide of copper, which in the reaction taking place in melting, gives an excellent brazed joint. Samples were shown which indicated that very many castings

which were imperfect or broken, could be saved from the scrap pile by the use of this method. (It has been described in these columns some time ago.) In general it may be said that any process which cheaply corrects the defects in important castings without weakening them is bound to be of service in the foundry, where indeed too little attention is given to brazing or "burning on."

THE FOUNDRY.

American Machinist, Dec. 4. Mr. R. H. Palmer reviews the progress of the foundry industry in a well-written article, going fully into the lighting, heating and good building question. Cranes, the cupola, good coke, blowers and all the foundry accessories are taken up in turn. He pays a great tribute to the benefit of metallurgy in the foundry, holding that its application was one of the greatest strides in the phenomenal progress of the industry. He also accentuates the necessity of proper charging and cupola management, and is right in this. Molding machines come in for their share of attention, as well as modern cleaning facilities. Mr. Palmer concludes by stating that while hand molding remains the same, it is now surrounded by many improved accessories, is carried on in pleasanter shops and with modern comforts.

METALLURGY IN THE FOUNDRY.

Mr. Percy Longmuir, our fellow member in England, recently delivered an interesting address before the Manchester Ironfounder's Association, on the relationship of metallurgy to the work of the founder. He went over the ground carefully, tracing the chemical, physical and metallographic relations of cast iron, the various properties and how to test them, and finally working out mixtures for the benefit of his hearers. Mr. Longmuir quotes copiously from the papers presented by him before our Association, and his efforts will certainly be of great benefit to his fellow-countrymen, in raising the standard of the foundry industry over there.

THE GERMAN NATIONAL ORGANIZATION OF EMPLOYERS.

Eesenzeitung, No. 46. For many years the German employer has been seriously injured by the arbitrary action of the unions, and hence there have been in existence many local associations intended

to counteract this evil. As these organizations, many of which are mentioned, sometimes clash, standing for opposing interests, a strong movement has been called to life to harmonize them all, and unite in one national federation of employers. This is all the more necessary, as it is found that the German Unions stand as one unit. In the publication of the new organization, the "Journal of German Employers," which, by the way, handles German industrials without gloves, there is no attempt made to gloss over sore spots, to coquette with socialism, but the point is strongly urged that in a strike which is ordered and led by a central labor body, all employers' interests become alike. On the other hand, while advocating organization to counteract this relic of barbarism, there is advised also a direct contact with social conditions in order to ameliorate the position of the workingmen as much as possible. To establish beneficiary funds in factories, improve workingmen's houses, establish employment bureaus, give technical education, encourage industrial research, as well as scientific investigation, collect statistical information, and, finally, watch the financial system of the state, and suggest internal improvement. Truly a large programme, and one we will do well to think about.

THE FAN BLOWER FOR THE CUPOLA PROCESS.

The Iron Age, January 8. In a paper on the above subject read before the Pittsburg Foundrymen's Association, Mr. R. B. Hayward goes into the question very thoroughly. Tracing the use of blast in the cupola from the natural method of simple chimney draught, he mentions the steam jet in the stack to bring about the same conditions. This, while evidently wasteful is still in use in Europe where local conditions prevent an open exit to the smoke and flame. The pressure blower as used in the Bessemer process was the next step, and the next of kin is the rotary blower. As Mr. Hayward has it, the pressure fan, or pressure blower, as it is sometimes called, has superceded them all. In spite of this statement, the rotary pressure blower will be found in a very large percentage of the important foundries of today. There are two general forms of fans, the propeller or disk wheel, and the peripheral discharge fan with enclosing case. The former is valueless for the cupola, and the latter can be built for either volume or pressure, this often as high as 20 ounces. Mr. Hayward goes very fully into the ques-

tions of air movement and sums up the argument in that the province of the cupola blower is to furnish the volume of air necessary for proper cumbustion of fuel required for the melt. This volume of air to be at such pressure that the resistance to its flow in the cupola is overcome. It is necessary to have your fan amply large enough to furnish the air required and the pressure high enough to overcome all resistance in the piping, etc., as well as that of the cupola. The pressure may be from 4 to 16 ounces, really depending upon the skill of the melter. A pressure guage should always be available. Mr. Hayward concludes with a number of hints on piping up properly.

THE PROPER VALUATION OF PIG IRON FOR FOUNDRY PURPOSES.

Eisenzeitung, Oct. 16, very emphatically endorses the proposal to test pig iron for foundry purposes, recently made by Dr. R. Moldenke. It also seems to be well know in Germany that irons of the same composition, when remelted, may show entirely different physical properties, and that for that reason one is not safe in predicting the strength of the casting from the composition of the iron used. It would therefore seem a very proper procedure to apply such tests in connection with pig irons, after they have been remelted under standard conditions, that their strength may be known to be good. In this way weak irons can be weeded out for important work. The Journal quoted says that while America has done much less than Germany along these lines, yet the idea could well be studied there as resulting in not only raising the standard of the foundry raw material, but for settling disagreeable disputes.

CRANE SERVICE FOR THE FOUNDRY.

Engineering Magazine, January. Crane Service, according to Mr. Robert Buchannan, the cupola alone excepted, ranks highest in importance in the foundry, the pace of all the operations going with it. Jib Cranes in the middle of the foundry floor are now back numbers, the pipe foundry alone excepted. The jib crane, as an auxilliary to the regular traveler, is however excellent. Here it takes care of the numerous lesser operations of the molder. The best arrangement is when connected to uprights along the wall, every alternate one being higher, so that they may overlap in handling work, the radius of all being greater than half the distance

between the cranes. A jib crane is wanted in front of the drying oven, and at every pit. Mr. Buchannan does not think that the electric or the hydraulic crane is economical unless there is use for this installation in other parts of the establishment. Over here we think differently, often putting in the plant for crane service first, and then extending its usefulness. The rope-driven crane seems to be the main stay of the English foundry. Mr. Buchannan gives some hints about what to keep in stock for the likely break-downs. Steam cranes come next. The electric crane does not seem to find favor fast in England, which may account for their falling behind us. The article now takes up cores, core-ovens, drying ovens, and methods of skin drying molds on the floor. As an interesting core mixture, the following is given: One wheel-barrow of burnt sand from castings, five similarly of molding sand from the floor, and 1 ¾ lbs. of Dextrine to each three hundredweights of the sand.

NEW METHOD OF LINING CUPOLAS.

The Foundry, January, gives the details of a new method of cheapening the cupola lining. Simply stated this means the use of hollow cast iron blocks above the melting zone. As iron will not melt unless heated up to a point considrably beyond that found in the upper part of the cupola, the idea would seem to commend itself. And as these blocks are much used in England, they must find advantages in the method over there. So long as this lining does not extend too far down, where it would at once give trouble, it would certainly avoid the wear and tear incident to much of the charging.

RISERS.

The Foundry, January. Quite a discussion is going on as a result of an article by Mr. Loudon, in which he claims that risers should be left open. Mr. Harry Willis gives several examples where the use of the riser, left open, but placed so that it acted practically as a safety valve for the iron from the increased pressure of a high pouring basin, gave good, unstrained castings of the right thickness. Wherever there are thick hubs, and the gate is at the hub, these should be carefully fed. Risers at the rims of pulleys and on teeth of gear wheels should not be tolerated, but they are very beneficial where there are high points on irregular castings.

especially in the case of cored work and when there are pockets which may imprison bubbles of air. Mr. Jos. A. Murphy also reviews Mr. Loudon's original article on the subject. He says the practice should vary with the requirements of the work. In some cases an open riser is the only way to secure good results, but usually the other method obtains. In any case, risers are never to be opened when the mold is half full. Mr. Murphy further disagrees with Mr. Loudon as to the test the latter made to prove the advantage of an open riser. He claims that the result should have come the other way. The two gentlemen also differ as to the highly interesting "dumb-scab." We hope to hear more of this discussion.

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS

Journal of the American Foundrymen's Association.

VOL. XI. MAY, 1903. PART III.

STEEL CASTINGS AND THEIR USE.

Stahl und Eisen, Jan. 15. Mr. Bernard Osann, in a recent lecture before the Metallurgical Association of Upper Silesia, reviews the condition of the steel casting industry as evidenced by the Duesseldorf Exposition. The saving in weight and improvement of quality in material has been the keynote of the successful introduction of the steel casting; The reduction in weight from the standpoint of freighting in the export trade seems to be the most prominent feature German producers are concerned with, as their transportation facilities are far behind ours in point of magnitude and economy. Mr. Osann described how the conditions of the ship-building trade required results which seemed impossible, but which were ultimately attained, these remarks reminding us of the time when the stern posts, etc., of our battle ships also went to the foundries of the country. It was simply a case of compelling the manufacturer to furnish what the industry required, and he succeeded better than he thought. Mr. Osann now gives the history of the steel casting industry very briefly, the invention dating back to 1851, and being made by Jacob Mayer. The great trouble with steel castings was always in the hot and cold cracks, but the study of these phenomena finally furnished the means to overcome the difficulties. In the first place a very pure material was required, then a very quick removal of the molding sand to allow proper contraction without tearing apart the casting. Then again it is necessary to design the casting in such a way that undue straining is avoided, a point to be well thought over even for gray castings. On the whole it is better to anneal important castings on general principles, in order to overcome the tendency to crack by reason of internal strains. The temperature selected for this purpose should be between 1300° and 1500° F.. preferably an exact temperature best

found in practice and constantly checked by the Le Chatelier pyrometer. Special care must be taken to avoid shrink holes. The importance of this will be seen from the fact that a locomotive frame of about 30 feet required 32 pouring gates and risers to come out sound. An interesting method of obtaining the dimensions of the sink head for a casting is given, which shows by means of the lines of continuous setting just how large an area is required in the riser to allow liquid material to flow into what would otherwise be a shrink hole in the interior of the casting. Mr. Osann now advises the steel founder and the industrial engineer to get together more especially for electrical, mechanical and ship-building work. He advises that experiments be made on the permeability of steel castings (which are now being carried out in this country) and especially that the question of annealing castings be given more attention, which is also the case here now, as annealed castings are specified more and more in our work. A series of descriptions of special castings exhibited, as well as special kinds of steel for casting purposes, concludes the interesting article.

WASTE IN THE FOUNDRY.

The Foundry, February. In the *Mechanical World*, an English foundry foreman condemns the awful waste going on in our foundries by careless men. He describes the making of a mold and the incidental losses connected with it, such as pounds of nails, chaplete, screws, studs, and other expensive articles, all of which should be charged up to the molding cost and much of which is a dead loss by being dropped into the sand. When more are wanted for the next job a new supply is gotten from the warehouse. Then the loss of plumbago, wooden wedges, spikes, etc., all of which are dead loss. Then come the losses in other directions such as wasting fuel in drying ovens, etc., when these are not needed, not to speak of the time lost in looking for things in the scrap pile. Where loam jobs are stripped off many a good brick is split up by the laborers. Lots of good coke is lost in the cupola refuse, not to speak of the iron. So it goes all through the foundry, and it is really a wonder that some places still exist.

THE LIFE OF INGOT MOLDS.

Stahl und Eisen, March 15. Mr. P. Reusch calls attention to the injurious effect of arsenic on the life of an ingot mold. Over in Europe it seems that the Spanish and Grecian hematites used often run 1.5 per cent in arsenic. Then the blast used should not be too high in temperature, otherwise the iron is injured. The composition of an exceptionally durable ingot mold, cast of charcoal iron, is as follows: Silicon 1.27; manganese 1.29; phosphorus .147; sulphur .061; total carbon 3.87. And yet a coke iron ingot mold of this composition would not stand 10 casts. For these irons the manganese is entirely too high, and it may be added from our standard, that the silicon, sulphur and phosphorus are too high also. Mr. Reusch holds that the composition is not the only thing affecting the life of an ingot mold. The metal should be poured hot enough to avoid cold shuts; the mold and casting should be allowed to cool very slowly. To facilitate an even cooling of the ingot the inner walls of the ingot mold are often made slightly convex so that in expanding they will practically straighten out flat instead of leaving a space for the running out of some of the steel of the ingot. Then again the lower part of the ingot should be ribbed to some extent so that this portion of the mold can resist the hydrostatic pressure better. The American system of pouring ingots with the molds upon moving trains of cars is commended as vastly better than pouring in soaking pits, but still better should be the method used in Germany of taking the ingot mold after stripping and plunging into water, the idea being to cool the inside and outside quickly but evenly. Ingot molds should not only be made properly, but should also be used to the best advantage.

MELTING STEEL WITH CAST IRON.

The Iron Trade Review, March 26th, gives the paper by R. P. Cunningham, on the above subject, recently read before the New England Foundrymen's Association. He refers specially to makers of pumps, for which a high tensile strength is essential, and moreover a clean, smooth article is also required. The judicious use of steel scrap is very advantageous in the first consideration, and care in the work helps the other. Mr. Cunningham's method of charging the cupola is as follows: The bed of coke is 1200 lbs. On this comes 1000 lbs. iron, then 500 lbs. steel, 500 lbs. iron; then

200 lbs. coke, 500 lbs. steel and 1500 lbs. iron. The thinner the castings the smaller the percentage of steel allowable; in fact it is desirable to use no more steel in the mixtures than is just right for the purpose wanted, the difficulties in handling increasing greatly with the higher steel percentages used. Mr. Cunningham now describes a series of 18 heats, with percentages of steel running from 20 to 45, and the results show a very great regularity. The conclusions reached from the paper indicate that only the strictest supervision will produce uniform results in melting steel with iron in the cupola. Without this nothing of value may be expected.

MALLEABLE CASTINGS PLANT IN EUROPE.

The Iron Age of February 26 reviews a recent article by the German foundry expert, Mr. Bernard Osann, in which he describes the largest malleable casting plant in Europe, that of Gelsenkirchen. The works in question have two cupolas, each capable of making two tons per hour, from which it would seem that they are very small ones indeed, the fuel ratio being 1 to 3.9, which is about right. The charge is 71 per cent. wrought iron and steel scrap, and 29 per cent. pig iron, much of this scrap being recarbonized by the process. The castings, being small mine car wheels, are placed into cooling ovens in order not to crack, and then go into the anneal. Here they remain 21 days, or three times as long at least as in our process. As no boxes are used, but the castings go into the ovens direct with a packing of iron ore, there is lots of trouble for the employees. A series of tables showing the chemical changes completes the paper.

OVERHEAD TRAMRAIL SYSTEMS IN FOUNDRIES.

The Iron Age, January 22. At a recent meeting of the Philadelphia Foundrymen's Association, Mr. A. W. Moyer read a paper on overhead tramrail systems in shops and foundries, and went into his subject very thoroughly. These systems, which are conveying methods are great money savers, and any shop handling many small pieces daily will do well to look into them. Labor is saved, the floor space is not obstructed, and there are many exam-

ples of saving the entire cost of such a system in the first year of its installation by the economies effected. Mr. Moyer described his own system, and then showed a number of installations by lantern slides. The general opinion of the foundries where these systems are in use is that an I beam installation, no matter whose make, is the best for all-around efficiency and reliability. Patent styles of rails are not in it with the plain I beam.

GRADING AND MIXING IRON BY ANALYSIS.

The Foundry, February. Dr. Edward Kirk writes about the remarkable change from fracture grading to that by analysis, and predicts that it is only a question of time when the old style of grading and mixing will be entirely obsolete. After showing how easily the founder can get the composition of the castings he wants to make, and from this the iron he wants to buy, he warns the maker of specially good work not to rely entirely on this simple method, but to study the fine points of chemistry for the foundry so that special questions of strength, density, etc., may be solved in a proper way. Dr. Kirk is right. Only a close study, and perhaps years of it, will show just how to use pig iron properly, and the sooner methods of testing pig irons are devised which will tell us what they really are, the quicker we will arrive at methods of producing castings, the quality of which will be beyond what they are now.

CARBIDE OF SILICON FOR FOUNDRY USE.

The Iron Trade Review, March 19, goes into the use of this compound for steel works and foundries. In the former its advantages are undoubted, as it replaces ferro-silicon, which cools the metal too much unless previously melted. For foundry purposes, however, the results have so far been negative, as the metal is not hot enough to take up the silicon carbide readily. This is no reason why it should be put aside, and we hope to see more done with it, as in furnace work it would quickly give silicon, where required, without chilling the bath.

IRON IN COPPER AND ITS ALLOYS.

The Brass Founder and Finisher, December 15, quotes the article of Mr. E. S. Sperry, in *The Aluminum World*, anent the presence of iron in brass and bronze. Iron was formerly considered a very bad impurity in copper, and rightly so where it was present in mechanical mixture. Where, however, it is in a chemical combination things are different, as for instance in sterro-metal, delta-metal and manganese bronze. Here it is rather good than otherwise, though persons who have run across iron nodules in sheet brass or other classes of brass goods to the cost of spoiled tools will not take kindly to this statement. As we have no method of directy alloying iron with copper or brass it is necessary to first alloy iron with zinc or make a manganese iron alloy to put in with the copper, etc.

SKIN DRIED MOLDS.

The Foundry, February, has a short article by Mr. George Buchanan, in which he describes his experience with skin dried molds. By an accident he overcame a lot of scabbing in making condenser end covers, and as a result he continued to place a little coke fire bucket where it would do the skin drying for him. As a result of his success with this method he recommends the use of these fire buckets, which amounts to practically working with dried sand molds. The method is in effect a simple form of the coke stoves with air blast used so much in Europe for special molds where skin drying is essential.

DIPPING BRASS.

The Brass Founder & Finisher, February 15. Mr E.S.Sperry, in *The Aluminum World*, takes up the subject of dipping brasses, that is, those brasses which on being dipped for a short time in strong nitric and sulphuric acids assume an even, clean, bright, uniform surface. As to the mixture it may be said that plain copper-zinc alloys answer best, and the requirements are freedom from blowholes, homogeneous structure. The alloy should be uniformly attacked by the acid, and castings must be free from sand and other adherent matter.

MODERN CUPOLA PRACTICE.

The Foundry, February. Mr. F. W. Stickle goes over this question at length, showing that the modern tendency is to decrease the diameter of the cupola and to raise the charging door; to have a blast belt connecting double and triple rows of tuyeres; finally, to make special internal arrangements of the tuyeres and the cupola bottom. In this way the heat of the combustion is taken advantage of while formerly it escaped at the stack without imparting heat to any series of charges above. Mr. Stickle recommends only 14 inches between cupola bottom and tuyeres, the idea being to get the iron out so fast as may be to prevent contamination by sulphur from the coke. The second row of tuyeres is a special advantage now generally recognized as giving a much more perfect combustion. The charges of iron should be the same throughout and not larger over the bed of fuel. The appearance of gases at the charging door soon indicates the condition of the cupola as well as the air supply. Care taken with the bottom will always repay itself and conditions can be regulated so nearly that 10 lbs. of coke more or less will be noticed in the results. In addition Mr. Stickle advises foundry foremen to study their cupolas continually, so that the best results in them be realized.

MOLDING FROM HALF PATTERNS.

The Foundry, March. Mr. John W. Graham describes a labor saving method of molding half patterns which, while not new, is interesting. An ordinary half pattern, say a Y or T, is laid upon a follow board which has two plates inserted to receive the flask pins. A central line is drawn on the follow board, the pattern being placed on the board guided by this line. The flask is fitted with the same plates, loose steel pins being used. When everything in ready the nowel can be rammed up and the pattern drawn. Then while it is finished the cope can be made, and thus much time saved. skeleton half patterns can be readily used, and an assortment of such specially prepared boards will prove a profitable investment in any foundry.

FUSIBLE ALLOYS.

The Brass Founder & Finisher, December 15, gives a list of

fusible alloys, of which we take a few, useful for soldering purposes as well as for delicate castings. An alloy which melts at 158° F., is made of 3 parts lead, 8 of tin, 4 of bismuth; 1 to 2 parts mercury added increases the fusibility. Newton's alloy, a standard fusible metal, is made of 8 parts bismuth, 5 of lead and 3 of tin. For delicate castings a cheap alloy is 6 of bismuth, 3 tin, and 13 lead.

ORGANIZED LABOR DECISIONS.

The Iron Age, March 5, gives an excellent summary of court decisions on disputed labor points. The article in question is by Mr. Jas. A. Miller, and is reprinted from Vol. II, No. 1, Bulletin Corporation Auxiliary Co., Cleveland, O. Mr. Miller deplores the fact that the court is not more often invoked to protect the rights of the party suffering interference at the hands of irresponsible outsiders. He states that ignorance on the part of a manufacturer of the decisions of the various courts is the reason as well as ignorance on the part of lawyers as to what constitures a labor union. Mr. Miller now explains the terms "unlawful," "common law," and "labor law." So far as the rights of the employer and employed are concerned each individual may carry on his business or give his labor as he pleases so long as he keeps within the law. Any loss occasioned to others under these circumstances cannot be recoverable. Men have a perfect right to strike provided they break no contract and aim at nothing unlawful. They may persuade men who are not under a contract and who do not object to listen to them. Picketing as it exists today is entirely unlawful. Intimidation by strikers is unlawful and can be quickly punished. The boycott and sympathetic strike are also unlawful. The methods used by unions to intimidate their members by means of fines are unlawful. The idea of injunctions is really to prevent the multiplication of court suits for each striker every week or month and an appeal can easily be taken and hardships prevented. Mr. Miller urges the formation of associations whose object shall be the settlement of legal points involved in labor troubles through the courts.

REGULATION OF CUPOLA MIXTURES.

The Iron Age, January 22. In an address before the New England Foundrymen's Association, Mr. W. J. Keep discussed the best

method of regulating mixtures for the foundry. In weighing his charges Mr. Keep prefers to begin with the high silicon pigs of the mixture and wind up with those low in that element, thus lessening the chances of error in the mixture as calculated. From his experience with the cupola Mr. Keep finds that the loss to be allowed in the melting process is 0.25 per cent. for silicon. The cupola has a tendency to increase sulphur up to .03 above that of the mixture. A series of interesting figures are given on the melting loss of various kinds of scrap as well as the method of ascertaining this. Then Mr. Keep gives the laws relating to the effect of the constituents in cast iron which are well worth repeating here.

Carbon lowers the melting point and shrinkage, and when combined hardens cast iron. Graphitic carbon is deposited between the crystals of iron after they are formed, and the decreased strength of such iron is on account of the loose grain. Silicon added to white iron turns it gray, by changing combined carbon into graphite. As silicon is the only element which it is practical for the founder to use for this purpose and to decrease shrinkage, it is the controlling element. Phosphorus does not influence carbon, but reduces strength more than and other element. Sulphur is always present, but is of no benefit. It is sometimes freely absorbed by melted iron, and at other times, when the conditions seem the same, it will not do so.

Manganese hardens castings. Sometimes it combines with sulphur and enters the slag, but if manganese and sulphur both remain in the iron, the manganese does not counteract the influence of the sulphur.

FOUNDRY DEVELOPMENT IN ENGLAND.

Eisen-Zeitung, No. 8. A good deal has been done in England recently to improve the foundries there, and this may be traced directly to the effect of America desiring to build up an export business there, notably the Westinghouse Electric Co., and the manufacturers of cupolas and molding machines. Especially in the application of the molding machine do we see a marked improvement, as this means much for the future status of their export trade. In addition to the above the matters of heating and ventilating are also

looked into more, and conveying apparatus finds a more ready application. Taken all in all the movement seems to date from the advent of American methods, brought there by our representatives and taken back by English visitors here.

STANDARD PIPES AND SPECIAL CASTINGS.

The Engineering Record, January 17, in an editorial on the above subject discusses the recent standards presented to the New England Water Works Association by its committee. These have been mentioned in our "Reviews" before, but attention is again called to this work, as it includes standards for straight pipes not only, but for special castings, such as curves, various kinds of branches, reducers, sleeves, caps, etc. The economy and convenience which results from a good set of standards cannot be overestimated, but the interesting point to the foundryman lies in the fact that with these standards in general use it is possibls for him to keep a small stock always on hand for the convenience of the municipality, etc. This really means that he can fill up odd days with this work when other orders are coming in slow.

CAST IRON SECTIONAL STEAM BOILERS.

The Engineering Record, January 24. Mr. J. J. Blackmore recently read a paper before the American Society of Heating and Ventilating Engineers, in which he advocates a proper rating of cast iron sectional boilers. It is well known that for heating purposes this type of boiler has no equal, for which we foundrymen are truly grateful. With proper rules for figuring out the effective heating surface Mr. Blackmore thinks one of the great difficulties of the designers of buildings in which these boilers are used will be removed. He is right in this, and his methods proposed deserve the full attention of those of our foundrymen interested.

STREAKS ON CHILLED SURFACES.

Iron Molders' Journal. In order to keep chilled surfaces from

streaking it is neeessary to pour the mold as quickly as possible, a point always made in a car wheel foundry. Dull iron and too heavy a chill are apt to leave scars on the chilled face of the casting. To prevent chills from sticking use ordinary pattern makers' shellac, having the chills warm before the application. By coating a warm chill there is no dampness to contend with afterwards. Big gates, hot iron and a quick pour will do the trick.

ANNEALING WHITE CASTINGS.

American Manufacturer describes another quick anneal process gotten out by our old friend Dr. Hunter, who has experimented long on lines intended to shorten the annealing process for malleable castings. This time he uses nitric and sulphuric acid gases. He takes care, however, to raise the heat very high, and suggests that "if you don't at first succeed, try, try again." As a matter of fact the whole annealing process depends upon the heat treatment the castings are subjected to, and not upon the packing or atmospheres introduced. With castings of the proper composition and with the right degree of heat applied, the packing or lack of packing material is not essential, as it is just as easy to anneal in fireclay as it is in "scale".

LIMITATION OF OUTPUT.

The Foundry. The recent deliberations of the National Founders' Association are reviewed by Mr. Jas. A. Murphy, who dwells specially upon the restriction of output practised by the molders' unions. Whatever may be the method used, the interference of one man with another regarding the amount of work he puts up is intolerable and forms the most serious complaint of the founder today. Good wages and the best of working conditions we all want to see, but the unwarranted intrusion into the rights of others must be stopped. Molders are becoming more liberal in their views regarding the output, but the floating element holds fast to the old and unjust custom. Mr. Murphy asks that the local unions be made to embody in their charter a clause forbidding any interference with the day's output, on penalty of its forfeiture. He cites an example

of restriction of work such as we all have gone through, and gives his method of overcoming the particular difficulties. The minimum wage rate also comes in for heavy scoring, and deservedly so, Mr. Murphy holding that 90 per cent. of the ordinary molders are not worth their shop room on first-class work, and these are the men who sputter most about "union principles." Many a molder is worth twice the minimum rate. and many more only half of it, while many foundries are watching every chance to take advantage of the men employed, on technicalities, so also are many men doing this with their employers. The golden rule is just as good in the foundry as elsewhere.

STEEL FOUNDRIES IN THE U. S. AND CANADA.

The Iron Trade Review, February 26, gives a list of all the steel foundries in this country, from which the following may be noted. There are 85 plants in operation, or nearly as many as in the "malleable" business, the output of castings being considerably less, or a little over 300,000 tons per annum. 57 foundries are using the open hearth method, 11 the Bessemer, and 10 the crucible. 7 foundries make steel castings by other special processes which it would be interesting to know as a bit of metallurgical news. Six other steel foundries are projected.

RATING PRESSURE BLOWERS.

The Iron Trade Review, March 5, gives the paper of Mr. G. C. Hicks, Jr., on the above subject, which was recently read before the Pittsburg Foundrymen's Association. After giving some interesting history in relation to the original conception of the idea and its application to the melting of iron, Mr. Hicks describes the blower in detail. The impellers are not run in actual contact, but have a clearance of less than 1-64". This clearance is afterward taken up with a grease which makes a tighter joint, the actual loss of air being between 6 per cent. and 10 per cent. As the friction is practically a constant quantity the loss of work through it becomes smaller as the pressure increases, hence it is more economical to use

a blower at high pressure than a fan. This point of economy lies between 7 and 9 ounces. Mr. Hicks now enlarges on the advantage of a vibratory blast pressure to help otherwise disadvantageous piping requirements. The total efficiency of the rotary pressure blower installation is 73 to 75 per cent. Where a very high pressure is used, as in smelting works, 90 per cent. efficiency is often met with, and only 7 per cent. air lost. Mr. Hicks finally advises ample blower capacity for the cupola and ample power for the blower.

SPECIFICATIONS FOR COKE, IRON AND SAND.

Engineering Magazine, March, 1903. After some general remarks on the advantages of buying by specification, Mr. Robert Buchanan takes up the purchase of pig iron and shows that he still has some of the old fracture methods clinging to him. Perhaps this may account for the rather unfavorable results our American foundrymen have had with their recent purchases of pig iron from England, while those from Germany, where the correct composition was available, were perfectly satisfactory. Mr. Buchanan, however is desirous of having analyses accompanying offers of iron, and we hope he will succeed in getting the American method of buying pig iron adopted over there too, for the benefit of the foundry industry. It took us long enough over here to arrive at this point. The sand allowance of 28 lbs. per ton seems to cut somewhat of a figure over in England, its allowance or refusal having a direct bearing on the sale. Scrap and coke specifications are next taken up, and we are envious to note that England can specify low sulphur coke, while over here we must take what we can get at present. Fluxes, refractories, facing, etc., are finally taken up; the special brands discussed being local, would not affect us over here, especially as we rather prefer to buy our supplies in these lines direct from the best makers.

MOLDING BY HAND AND MACHINE.

Engineering Magazine, February. Mr. R. Buchanan continues his articles on foundry management in the new century. These

articles recapitulate the methods we are well acquainted with and need therefore to be but briefly reviewed. Under molding by hand we have the "bedding in" process, which is more expensive but saves flasks. Where flasks are used they should be as much as possible of an interchangeable nature, so that the supply of sides, ends, pins, etc., may be limited in sizes. A number of illustrations are given showing a very good interchangeable flask. Further information is given on small iron flasks. We, over here, prefer the snap flask for "repeat" work, and Mr. Buchanan says that the use of this method is not too prevalent in England, and should be studied by English foundrymen. He therefore goes into the question at length. Hand presses, or, as we call them, "squeezers," come in for some explanation next. Then methods for grinding "facing" are discussed, we, over here, preferring to buy this material from reliable makers. The mixing of facing and molding sands seems to be done over in England as it is here.

RECOVERING IRON FROM CINDERS.

The Foundry, April. Mr. W. J. Keep describes his method of recovering the shot and iron from the cupola dump. We give it in his own words:

"After the blast has been shut off and all of the melted iron has been drained from the cupola, make a dam on the floor in front of the cupola spout, about 4 inches high, enclosing a semi-circular space having a radius of about 4 feet. Let the melter lay a tapping bar across the spout and have three or four laborers, with a piece of old 1½-inch shafting about 8 feet long, ram in the breast. If the bottom and spout have been made right there will be no melted iron in the cupola, but run the ram back and forth to allow all to drain out. All of the liquid slag in the cupola will run into the enclosed space underneath the cupola spout and if there is any iron among this it will run through the slag and lie on the floor in the form of a slab which can be picked up the next morning. When the cupola has been emptied of all slag and iron, drop the bottom. I like to draw the refuse out from underneath the cupola, turning it over and cooling it down with water.

"The next morning, there being no slag in the dump, the coke

can be readily picked out and returned to the charging platform, to be used as the melter chooses, as it has been weighed once and charged to the melting of the previous day. The pieces of the cupola sand bottom are thrown to one side and all the iron that can be seen is picked up. All iron taken from the cupola dump, the pig bed or from the gangway, which is not bad castings, is weighed up and charged as remelt or home scrap. All remaining small pieces of coke, iron or slag are shoveled up from the bottom and from all parts of the foundry and placed in boxes on the cupola platform. This includes skulls from the ladles which contain more or less iron.

"When the last charge of iron has been placed in the cupola and the heat is near enough to the end to show that there will be no shortage of iron, throw into the cupola any shot iron that may be left over and all the refuse previously mentioned. The iron and slag will all be melted at once and the small bits of coke will hold the blast down and insure hot iron.

"All the finest shot iron is in this way saved, as well as all coke in the form of small pieces, and nothing is lost. There is no increased expense of handling, since the absence of slag gives less work in picking over the cupola dump; all the necessary labor connected with the cinder mill as well as the power to run it and general wear and tear is avoided. I have never used a magnetic separator, but I understand that after the cinders have been crushed they are run over a four or six-mesh screen to remove the sand and fine material before this reaches the magnetized portion of the machine. It is the fine particles that would pass through this screen, as well as all the balance, that my method will save."

GATES AND SPRUES.

The Iron Trade Review, February 5. Mr. D. B. Fuller recently read a paper before the Pittsburg Foundrymen's Association on proper methods of gating up. The first thing done in the foundry when a pattern comes in is to determine how to gate it up, and Mr. Fuller gives several examples how not to do it, as well as the methods which give the best results. Here are a few illustrations :

"I have in mind a pattern for a coping used to cap off a stone

wall. This pattern was shaped like the side and top or roof of a wall-tent. It was not feasable to force all the iron from the bottom gate, the casting being very light, and from its shape the consequent strain upon the mold was very great, to say nothing of the difficulty of running when thus gated. At the first line of parting, or at the bottom of the roof slope, was a sharp beading of sand running the full length of the pattern, which made this undesirable as a place of gating, as the iron striking this beading caused washing or cutting away of the sand. Along the highest point, or as I might say for illustration, the peak of the roof, were cast in a row of wrought iron spikes in such a manner as to prevent the placing of "pop gates," or top pouring gates. The mold was made in three parts, the cope line being about 4 inches below the highest point of pattern, on this parting the gate was cut.

"The casting being poured double, a runner was cut the full length on either side, and about 6 inches back from the pattern, sprues were cut from these runners to the casting, about 3 inches apart. Now what I wish to illustrate is this: The molder cut the sprues deeper at the back, or where the iron was to leave the runner, than where they connected with the casting, thereby causing the metal to choke at the point where the mold was least able to resist the pressure, for owing to the shape of the pattern, there was very little support underneath the gate. When the mold was poured. the pressure coming upon this weak point, caused the breaking down of the gate and loss of the casting. This trouble was entirely obviated by reversing the shape of the sprues, cutting them smaller at the back, gradually widening and deepening towards the casting, with a slight dove-tail at the finish, this keeping the pressure back in the runner and allowing a free and yet gentle flow of iron to enter the mold. No further trouble was experienced from gates breaking down.

"As another example, take what is known as the end bracket for brushless motors. It is a circular casting 6 feet outside diameter, having heavy hubs in the center, in which are the bearings for the armature shaft. Around the outer rim are bosses, where the bracket is bolted to the field casting, while the part between the rim and hub is principally composed of light checker work or grating, so made for the purpose of ventilation. In gating this upon the rim, the iron must flow first down and inward to the center; and

while the heavy hub is filling, the metal is slowly moving upward and outward amongst the grating. Thus cold seams are formed. But if what is known as horn gates are used, reaching from outside the circumference of the pattern underneath to the hub, thus filling the heavy center first, the balance of the mold is filled rapidly and cold seams avoided.

"Many and various forms of gates are used in the foundry, each with its specific use—the flat gate, the horn gate, the skimming gate, etc. As to the skimming gate, the old fashioned No. 6, when properly used, is reliable. In using this the sprue should be cut at such an angle that the iron, in the swirling motion, will pass the sprue, carrying the dirt and dross with it, and lifting it up into the head placed to receive it. This represents the principle used in casting rolls, where the gates are so placed as to cause the iron to form a whirlpool in the mold, thus carrying the dross to the center, and allowing it to rise up in the sinking head on top of the mold.

"Another excellent form is the tea-pot gate, where the metal must find its way down through the basin of the gate and thence upward through the spout to the sprue, allowing the dirt to remain in the top of the reservoir. The uses of the horn gate are manifold, but one example will suffice, that of the armature bushing. It is not good practice to pour this from the top, owing to the sharp bed of sand on which the iron would beat, this causing it to cut or wash away; but by filling the mold from the rim with the aid of the horn gate this is prevented.

EMPLOYER AND EMPLOYEE.

The Iron Age, March 19. Mr. W. H. Pfahler, the father of the movement to bring foundrymen and molders together, writes interestingly in the Bulletin of the National Trade Association on the question of conference and conciliation in labor matters. We append his conclusions, as well thought out :

1. That labor organizations are the natural result of a great movement in the business world which is replacing costly competition with profitable co-operation, and are formed primarily for the protection of their members, upon the theory that collective bar-

gaining for the sale of their labor is more profitable than individual contract.

2. The accomplishment of their object requires labor organizations to secure the membership of the largest number of persons employed in any kindred trade, and (because voluntary advancement of wages rarely or never occurs) to demand a change in wages and betterment of conditions whenever it appears that the need for their labor is in excess of the supply, and therefore warrants such demand. Labor organizations are necessary also to resist collectively any movement on the part of the employer which would result in injury to the workingman.

3. Whenever labor organizations by reason of false leaders have made unfair demands or established conditions which were unfair to the employer, it has been because of the use of collective force against the individual employer, and this has been defeated whenever the employers have organized similar associations for their own defense.

4. That strikes for advancement in wages and improvement of condition—occurring, as they do, during a period of prosperity—usually succeed, while strikes for recognition of the union, usurpaation of the rights of the employer or against the reduction of wages almost invariably fail in their purpose.

FOUNDRY RIGS.

The Foundry, April. The subject of rigs as a factor in the foundry is handled by Dr. Edward Kirk in an able article. Patterns are taken up first and metal ones are called for wherever possible, as preferable. They should be properly drafted to mold to the best advantage. Flasks should not be too large, just large enough being right. An excess of space to fill up with sand means time, and therefore money uselessly expended. Where there are proper foundry rigs in existence for handling flasks, etc., work may be done to such advantage that the loss of one shop means the profit of another. Dr. Kirk gives several instances of this, which show that good rigs are a paying investment. As a general proposition, special rigs pay, for if they are not provided the work must be done with higher priced men, and it takes more time in addition. So far as the pattern is concerned even relatively small orders should

allow them to be placed on the follow board—the time otherwise spent in making the partings soon paying for this. Dr. Kirk suggests the placing of a rig-foreman in large foundries as a paying proposition. He further advises that the molders who get up good rigs should be compensated for their ideas as an encouragement for turning out more work in a given time than would otherwise be the case.

THE MALLEABLE INDUSTRY OF AMERICA.

The Iron Trade Review, April 2, goes into statistics in connection with the malleable business, giving the plants of the United States and Canada, together with the tonnage equipped for, and also the plants projected. From the list we find that Illinois heads the list with 20 plants; Pennsylvania, Ohio, and New York following in the order named. There are 123 works, and the daily capacity is 3,052 tons, but this is not the output. While these capacities mean an annual output of some 900,000 tons, the actual amount will probably not exceed 750,000 tons, which in itself is enormous, as the combined output of the rest of the world is probably not over 50,000 tons per annum.

CUPOLA PRACTICE.

Engineering Magazine, April. Mr. Robert Buchanan continues his able articles on foundry management in the new century. The Cupola forms the subject of his present article. The tuyere arrangement will depend largely upon the class of castings to be made. With light castings they must be low, but the slag must be readily removable. For heavy work the tuyeres should be high enough up to allow plenty of iron to collect before tapping. The English method of using the fore-hearth is commended by Mr. Buchanan where the best mixing effect is desired. He admits, however, that there is a loss of economy where this is done. Over here we prefer to mix the charges properly in the first place and do the rest in a good large bull-ladle. In Great Britain they seem to use the solid bottom cupola universally, while here we seldom see this system. Mr. Buchanan recommends our system as the most

advantageous in the long run. On cupola linings we have still much to learn, the basic lining being worthless to us, but the acid, or fire brick lining leaving much to be desired also. The question of mixing by analysis now is discussed, Mr. Buchanan giving the limits of the elements for various classes of work. Good hot iron is a desideratum as it leaves the slag very hot also and this takes up much of the sulphur of the coke, which means comparatively better castings. Double rows of tuyeres are recommended, and properly so. A few points relative to lighting up the cupola follow. The fallacy of using high silicon irons with heavy proportions of scrap is gone into, the carbon being so reduced that excessive contraction results. Prof. Turner's discovery of the action of silicon on the carbon present is then commented upon, for this is or should be universally known to be the real starting point of the wonderful improvement of the foundry industry, so far as the material is concerned. The use of steel in the mixtures gets a few words of explanation, and then fluxes are taken up. Limestone naturally forms the standard flux; fluor spar has so far not been able to replace it. Really the only special advantage of account with this material is the remarkable fluidity given the slag. The melting loss is naturally a function of the scrap used. Then also the blast has much to do with it. It is a good thing to look into the slag for undue amounts of oxide of iron, as this shows up the working of the cupola. If the quantity exceeds 10 per cent. there is something wrong with the process. Overhead and track ladles are next discussed for the conveying of iron, and Mr. Buchanan finally deprecates the recovery of shot iron. If the recent figures of Mr. Putnam are of any value, there is at least a question for study in this.

EMPLOYERS' ASSOCIATIONS.

The Iron Age, April 9, in an editorial comments upon the recent growth of Employer's Associations. The movement was slow in getting under way, but the conditions in the labor market necessitates this action more and more. The systematic aggression of organized labor, which, though embracing only a small part of labor in general, yet assumes to be its sole representative everywhere, owes its strength to excellent organization and amalgamation of inter-

ests. This is now so serious that, the government being unable to deal with it, capital is commencing to take a hand in the matter to save itself and the people at large from untold tyranny. This movement is proceeding on two lines. One is the formation of Associations representing one trade or line of trade only, such as the National Founder's Association, which originated in our own body. The other way is in the direction of bringing together the employers of a given city or locality, such as Cincinnati, Dayton, Chicago, etc. Dayton is a conspicuous example of what can be done in a union ridden town. While formerly at the point of industrial ruin, the employers' association, after a sharp conflict, has destroyed this influence and Americanism rules today, and not trade unionism. In conclusion, attention is called to the fact that now is the time for closer union of employers for the purpose of resisting the encroachments of organized labor.

MOLDING SAND.

The Iron Trade Review, April 16. Mr. F. E. Gordon read a paper before the Pittsburg Foundrymen's Association on the above subject, on April 6th. Albany and Jersey sand has always enjoyed the confidence of foundrymen, whenever selected by experienced men. About 900,000 tons are shipped from the Albany district annually, which goes to show that much sand sold in the last 50 years, as coming from there, the vein being but 2 feet thick at best, must have been spurious. The next territory in age and reputation is that of Conneaut and Kingsville. Next comes the Sandusky territory, the sand from which is not so reliable as it is not handled systematically. The Pittsburg markets take much of the Zanesville sands as this seems to answer peculiarly well for heavy work. Mr. Gordon rightly holds that great care should be exercised in the selection of the sand as no factor costs so little yet has so far reaching effect as this. 5 cents more spent in sand is often more potent than $1.00 extra on the pig iron. The time spent by the laborer in mixing the sand, the size of the scrap heap, the appearance of the castings; all these factors combined, should be looked into when studying the sand question. Mr. Gordon concludes with this :

"The man who places his order early in the season for ship-

ment at regular intervals, as his wants may require, and counts on getting his winter's supply during July, August and September, and from that time on until the end of the season, and replaces, until the season closes, such as may be consumed, can afford to pay 10 per cent. for the money used and will be the sand man's best friend."

FOUNDRY ACCOUNTING.

The Iron Age, April 16. A very able paper on Foundry Accounting and method of estimating costs of casting was read by Mr. O. C. Barrows, a trained accountant, before the New England Foundrymen's Association on April 8th. The article has a number of tables and etchings of forms used and the interested reader will do well to study the article itself to get the value it contains. One point, however, is added in the concluding remarks of Mr. Barrows, and is given herewith. "If some such basis of estimating and keeping cost in neighboring foundries were in vogue in all, might there not be better results, prices better regulated, less friction between customer and seller? In every case the foundryman would feel that he was meeting fair competition, and that his success would demand the best facilities, best apparatus, best help, modern appliances, and close attention to details, while the figures kept and shown as indicated would prove and confirm from week to week the results of his efforts."

That is why we should like to see a section for Foundry Accountants established in our Association. With proper standard methods we might do away with many unnecessary losses in our business.

THE GRADING OF PIG IRON.

Engineering Magazine, April. In an editorial the above subject is taken up as a very timely one. To quote from the article, "The question of the strength and suitability of materials of engineering construction is being studied more and more, and the present tendency is to carry the practical investigation of materials back several stages beyond the state in which they enter into the completed structure. Thus the properties of the group of materials known under the gen-

eric name of steel have been traced back to the constituents of the pig iron, the furnace lining, the materials added in the converter or open-hearth furnace, the heat treatment, and other elements in its preparation and manufacture. In like manner the nature of cast-iron products is held to be largely dependent upon the character of the pig iron fed into the cupola, and this again upon the character of the ore, flux, and fuel delivered to the blast furnace. It has well been said that the raw material of one industry is the finished product of the other, and thus no product is entitled to be called raw from the moment that the hand of man has been laid upon it to apply it to any useful purpose.

"The extensive use of cast iron in all departments of engineering work renders it especially important that definite results should be attained within reasonable limits concerning the strength and character of the products of the foundry cupola, and hence the necessity of grading the pig iron which forms the principal supply of material for the cupola has long been appreciated. The old method, that of grading pig iron by fracture, has been found unreliable, since the appearance of the fractured end of the pig is now known to be dependant upon the rate of cooling and other considerations besides quality and composition, and hence various methods have been suggested to permit a more accurate knowledge to be obtained."

This is quite to the point, and shows our foundrymen how the users of castings feel on the subject. The article now goes into the two recent papers on the subject written by your Secretary, quoting the salient points and calling attention to the present state of the matter, as one which should be supplemented by further study for the benefit of the industries of the country.

COLORING BRASS BLACK.

The Iron Age, April 16. The beautiful black finish now produced on brass is a rather difficult tint to obtain, and this seems strange as brass left in the open gradually acquires a black tint from simple oxidation. An article in the *Metal Industry* goes into the matter at length, and it is said that the best method in use today is the immersion in a solution of carbonate of copper in ammonia.

The carbonate of copper is best bought in a plastic state, though directions are given to make it from the sulphate if desired. One pound of the plastic copper dissolved in two gallons of ammonia gives the required strength. First boil the brass in a strong potash solution to remove all grease, then immerse in the copper solution which has been previously heated up to 150° to 175° F., between which temperatures it works best. Leave in the solution until the required tint is obtained. Now rinse and dry in sawdust. The finish of the brass before tinting has an effect upon the final appearance. The red metals give the best results, the predominance of copper assisting in this. Where very yellow brasses are used it often pays to electroplate them with copper first.

THE STATE AS A PIPE FOUNDER.

The Ironmonger, April 11, in an editorial describes the situation in Australia where the government owns a large pipe foundry. Recently a large contract for cast iron pipe was to be given out for public improvement and the government bid in competition with those of a number of importers was so low that considerable comment was created. The Manager, however, claimed that his estimates were correct, and the contract was given the State. It goes to show that it is cheaper to import pig iron and fuel into Australia, than to import the pipe, and perhaps this will hold good in the future in other foreign markets.

THE NEW YORK PUBLIC LIBRARY
REFERENCE DEPARTMENT

This book is under no circumstances to be taken from the Building

form 419